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Casting Manganese Steel--I

Descriptions of the Open-Hearth Converter and Electric Furnace Processes Includes Methods of Adding Manganese to the Steel—Metal Softened by Heating in an Oven and Quenching

BY H. E. DILLER

This article with a second which will follow April 15, comprise one of the last important works of H. E. Diller, metallurgical editor, The Foundry, who died Jan. 17, 1924.

SOMETHING of the effects of different heat treatments on steels evidently was known ever since iron first was worked. If any theories were advanced for these different effects in the early days they were not based upon a knowledge of the constituents or structure of the metal. However, the early artificers understood the effects of heating steels to certain temperatures and quenching them with subsequent drawing of the temper. Certainly in the Middle Ages when the fine Toledo blades acquired their great reputation, workers in steel understood some points in quenching, tempering and otherwise treating this metal. However, the treatment was understood only

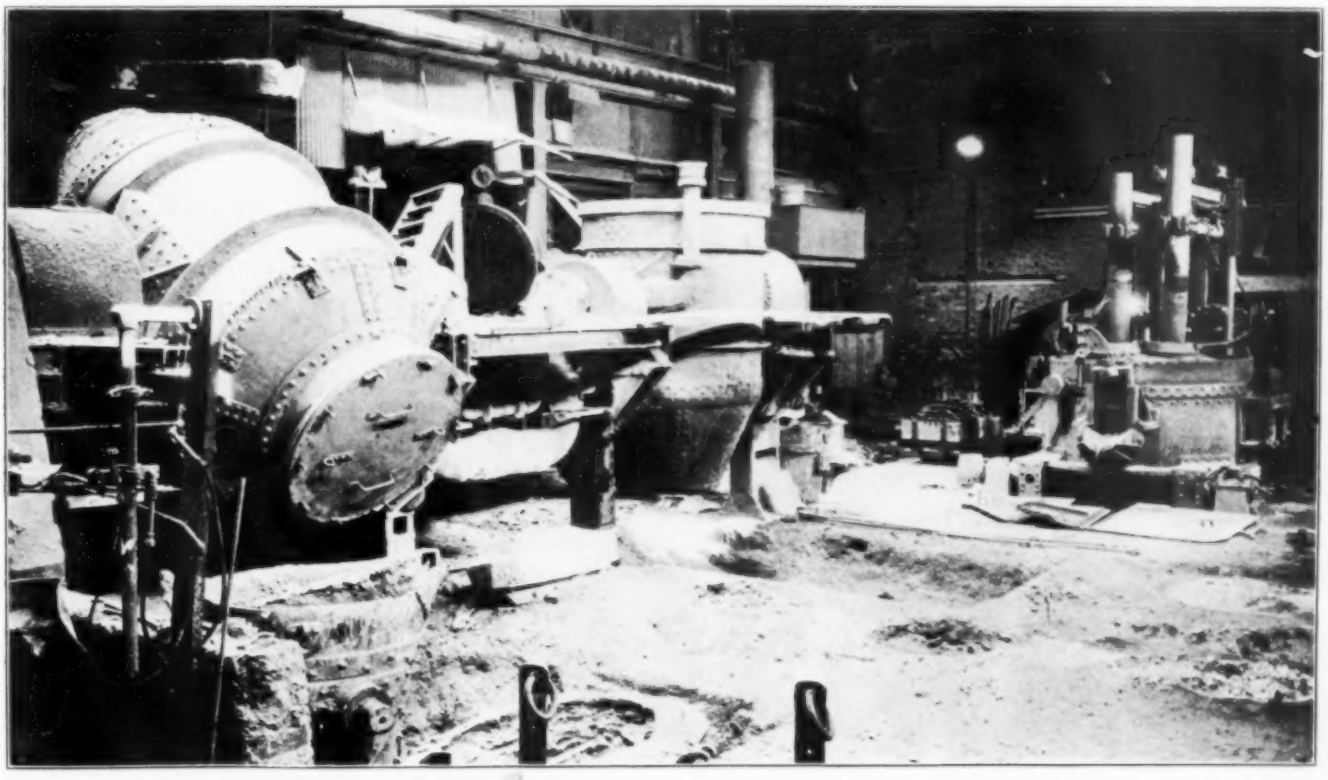


FIG. 1—CONVERTERS USED IN THIS SHOP FOR A NUMBER OF YEARS RECENTLY HAVE BEEN SUPPLEMENTED BY THE ELECTRIC FURNACE

FIG. 2—THREE ELECTRIC FURNACES IN A ROW MELT THE STEEL FOR ONE PROMINENT MANUFACTURER

by a few and acquired through long training in actual practice, determining the temperature by the eye and being governed by empirical rules. Not until 1872, when Prof. W. F. Barrett of the Royal College of Science, in Dublin, discovered the recalescence point of steel, was the first step made in heat treating according to definite prescribed temperatures. Shortly after this momentous discovery, it was found that the hardening of steel was connected with this recalescence point. These discoveries quickened the demand for accurate pyrometers and a more thorough investigation of the physical changes in steel brought about by heat treatment.

Not only was interest in heat treatment experiments on plain carbon steel stimulated, but investigations were made of the effects of varying proportions of alloying elements on steel and the treatment of such steel alloys. Among the alloys which have found wide use on account of their unusual physical characteristics is manganese steel, first made known in an exhaustive report by Robert A. Hadfield, published in the Journal of the Iron and Steel institute of Great Britain in 1888. He had discovered this steel in 1883, and later called it self-hardening steel. This metal was cast first in America in 1892 by the Taylor Iron & Steel Co., at High Bridge, N. J., now the Taylor-Wharton Iron & Steel Co.

Metal Hard as Cast

A hard brittle metal as cast, this alloy was found by its discoverer to become extremely tough when cooled rapidly by quenching from a high temperature. Such steel contains approximately 13 per cent manganese and 1.25 per cent carbon. While extremely hard and brittle when cast, the proper heat treatment will reduce its hardness from a brinell number ranging from 600 to 800 down to about 200, and its tensile strength will be increased to somewhat over 100,000 pounds per square inch with an elongation in 2 inches between 30 and 40 per cent and reduction of area of more than 35 per cent. The high elongation is due to the fact that the test piece stretches almost uniformly along its entire length, little necking taking place. The outer layer of the heat-treated

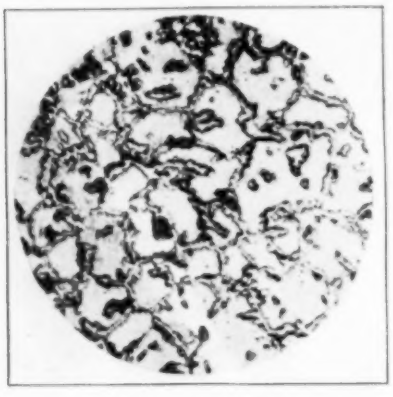


FIG. 3—MANGANESE STEEL BEFORE HEAT TREATMENT—X 100 DIAMETERS

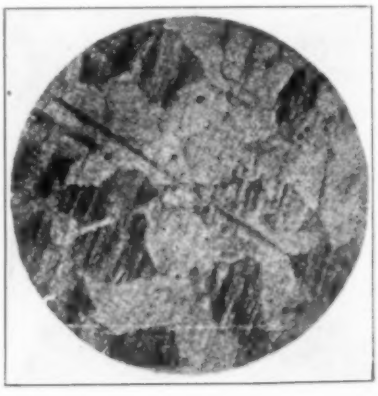


FIG. 4—MANGANESE STEEL AFTER HEAT TREATMENT—X 100 DIAMETERS

casting, to a depth of about ⅛ inch, is of somewhat lower brinell number than the metal behind it which is all of approximately the same hardness. Between atmospheric temperature and 600 degrees Cent. the heat conductivity is about 1/3 that of low carbon steel. The commercial product is non-magnetic, but the metal can be rendered somewhat magnetic by heating it for an extended time at temperatures from 500 to 700 degrees Cent. This magnetism is destroyed in a few minutes by heating to a slightly higher temperature.

Its peculiar characteristics are due to the formations caused by the high percentages of manganese and carbon. Austenite in manganese steel, which is the solid solution of iron and manganese cementite, sometimes termed manganiferous cementite, is a strong, tough constituent of the metal. This exists in the molten metal and when the casting is poured and cools normally some of the cementite which is an extremely hard substance separates out and renders the metal brittle. By heating the hard metal to 1000 degrees Cent. and cooling rapidly the austenite is reformed and the quick cooling prevents the separation of the manganiferous cementite. In plain carbon steels the austenite is difficult to hold in solid solution as it breaks up into pearlite below the transformation point. However, the transformation point in manganese steel is so much higher that pearlite is not formed. The difference in structure of the steel before and after heat treating is shown in the micrographs Figs. 3 and 4. Fig. 3 shows the structure before heat treating and Fig. 4 after heat treating, both are magnified 100 diameters.

Finds Wide Application

Naturally, a metal with such physical characteristics finds wide application in the industrial world. Its great wearing properties have made it valuable as a metal for track equipment such as frogs, switches and crossings, where until recently, when it has been displaced to a limited extent by heat-treated, nickel-chromium steels, it has been practically the only steel used for these purposes on tracks under heavy service. However, this is only one of the many uses to which manganese steel castings are put as castings of this metal have been adapted in innumerable places where high wearing properties are essential. These vary from large crusher plates and cylinders to the points of steam shovel teeth and links for chain. Its non-magnetic properties make it valuable as shields or bottom plates for lifting magnets.

The high shrinkage of the metal, which is 5/16 inch per foot in contrast to 3/16 to ¼ inch per foot in ordinary steel, renders the designing problems difficult. These troubles are accentuated by the strains set up in the metal during heat treatment, as the strains cannot be relieved by drawing the temper as in the case of plain carbon steel. When manganese steel castings first were made only the smaller sizes could be produced satisfactorily, but with the increase of knowledge of its properties and better understanding of heat treating requirements increasingly larger castings were produced until at the present time castings weighing over 25,000 pounds and sections up to 4½ inches thick can be cast successfully. So much skill is required in the proper design of the castings that patents have been taken out for some designs. The principal points to observe are to avoid sharp corners and not to have abrupt change of sectional thickness.

FIG. 5—HEROULT TYPE FURNACE POURING A HEAT OF ELECTRIC STEEL INTO A LADLE TO BE CARRIED BY THE CRANE TO THE MOLDS

Consider Characteristics

In deciding the process to use for the production of manganese steel its peculiar characteristics must be considered. Manganese is more readily oxidized than iron. Therefore, it would be impossible to retain the high percentage of manganese required in the metal if an oxidizing process were used. If

FIG. 6—FERROMANGANESE MELTED IN CRUCIBLES IS POURED INTO THE LADLE BEFORE IT IS CARRIED TO THE OPEN-HEARTH FURNACE TO BE FILLED WITH STEEL

an oxidizing process is decided upon, such as the open-hearth or the bessemer process, it is necessary first to make a low-managnese steel and add the manganese in concentrated form. The commercial form of high-manganese alloy most suitable for addition to steel to increase its manganese content generally is considered to be 80 per cent ferromanganese. As this contains more than 6 per cent of carbon, on an average, the carbon in the finished steel is apt to be excessively high unless precautions are taken to keep it at a minimum.

If made in a graphite crucible by melting manganese steel scrap with ferromanganese a prohibitory amount of carbon would be absorbed from the crucible which would be cut excessively.

FIG. 7—CASTINGS COMING FROM THE HEAT TREATING FURNACE MUST BE QUENCHED AS QUICKLY AS POSSIBLE—THE WORKMEN WHO SLIDE RAILS UNDER THE GRIDS HOLDING THE CASTINGS ARE DRESSED IN ASBESTOS CLOTHING

A low-manganese steel can be melted in a clay-lined, steel-melting crucible and enough ferromanganese to bring the manganese in the steel to the required amount can be melted in a separate crucible and added to the molten steel. However, this process is expensive and not used except in isolated cases where possibly a few small castings are to be made.

Before the advent of the electric furnace manganese steel was made commercially in either the open-hearth furnace or the bessemer converter. Both of these processes are highly oxidizing. Therefore, if manganese of the required amount is added at the first of the heat it is burned out before the steel is made. Naturally, in using manganese steel scrap in these processes an excessive loss of manganese would occur, and the value of the manganese would not be retained, except as it is used in the Swedish process to develop heat in the converter. Therefore, the disposal of manganese steel scrap to get the full value from it, was a problem until the electric melting furnace was adapted to the production of manganese steel. At first the comparative cheapness of manganese steel scrap served to balance the high cost of electric furnace operation. Then as the cost of melting in the electric furnace was gradually reduced, its use became more general, one of the largest producers of manganese steel put three electric furnaecs in one of its plants, and one in a second, while continuing with the converter in a third shop. The three heroult type furnaces of this company operating in the same shop are shown in Fig. 2. One is of 6 ton capacity and the other two of three tons each.

Another prominent manufacturer, while making the larger manganese steel castings from open-hearth steel has built a special foundry for the production of smaller castings from electric furnace steel. This 3-ton furnace of the heroult type is shown in Fig. 5, pouring a heat of steel into the ladle which is carried to the molds by the crane. A third manufacturer has introduced an electric furnace, also of the heroult type, to operate along with the two converters originally installed. A view of the converters and electric furnace is shown in Fig. 1. Metal from all the melting furnaces in a shop is sometimes employed to pour an unusually heavy casting.

With the adoption of the electric furnace for the production of manganese steel the demand for manganese steel scrap has increased its cost so that one of the original advantages for this process has been lost. As to any advantage which the electric furnace process has over the open-hearth or converter process, the claim is made and also refuted that the manganese steel made in the electric furnace is superior to that made in the converter or open-hearth furnace. That it is superior is not generally accepted.

As both the converter and the open-hearth process are oxidizing, and manganese is lost if added to the original charge, means must be provided for adding the manganese to the molten steel from the open-hearth or converter. Such a large percentage of this must be added that it would cool the steel in the ladle to such an extent that it would be impossible to pour it, if the manganese addition were not concentrated and added in the molten state. To this end 80 per cent ferromanganese, melted either in the electric furnace or in the crucible formerly was used exclusively. More recently a method of melting ferromanganese in the cupola without excessive loss has been developed and the process patented.

With its high percentage of carbon the addition of 80 per cent ferromanganese has a tendency to increase the carbon above the allowable limits. One company which uses the open-hearth process, melting the ferromanganese additions in crucibles, endeavors to have the carbon in the ferromanganese below 6.20 if possible so that the ratio of carbon to manganese in the steel will be approximately 1 to 10, the manganese being held around 11.5 to 12 per cent and the carbon about 1.15 per cent. The carbon is universally kept below 1.25 per cent. To keep the carbon eyen lower, experiments with silicomanganese have been made. This metal containing only 0.75 per cent carbon and about 68 per cent manganese permits the carbon to be kept around 0.80 per cent, if desired. However, the silicon content of the alloy is around 22.0 per cent and raises this element in the steel. One firm has made such steel with as high as 1.40 per cent silicon. So far this has not been found to be of disadvantage. Silicomanganese also is used when a heat melts down in the furnace high in carbon.

Sealed Crucibles Used

In one foundry, the ferromanganese is melted in a battery of 14 pit furnaces fired with coke and having a natural draft. The bottom of each pit contains the top of a steel ram covered with firebrick, and large enough to hold four crucibles of 60 pounds capacity each. The steel section being below the level of the fire is protected by the brick which cover it and is cooled by the draft of air entering the furnace. The crucibles are covered and sealed with fireclay before being introduced into the pit. Coke is piled around them and natural draft supplies sufficient heat to melt the ferromanganese in from 3½ to 4½ hours.

When the charge is melted and at

the proper temperature the ram is raised by hydraulic power and lifts the four crucibles above the floor level, as shown in Fig. 6. Here the first of the pits is being discharged. One workman grasps a crucible with a tongs held by a chain fall connected to a trolley operating on an I-beam. A workman, shown at the left, pushes the crucible with a steel rod and another carries the chain operating the fall. In this way the crucible is carried rapidly to the edge of the furnace floor where a ladle is provided to receive the molten metal. The required number of crucibles are emptied and the ladle then is carried to the spout of the open-hearth furnace to be filled with steel.

When the electric furnace process is employed manganese steel scrap may be charged with little loss of manganese, as nearly all the manganese is reduced in the refining process when a basic slag is used. The acid furnace cannot be used as the manganese strongly attacks silica sand. However, phosphorus cannot be taken out of the metal as is generally done when the basic process is used for making carbon steel. To do this it would be necessary to pull an oxidized slag which would carry with it a large amount of manganese. For this reason no attempt is made to lower the phosphorus in the electric furnace, but a low-phosphorus metal is used for the charge. Naturally steel made in the basic open-hearth and in the electric furnace will be low in sulphur, which usually runs below 0.03 per cent. Sulphur in converter steel is higher, usually around 0.08 per cent, on account of the metal taking up sulphur from the coke in the cupola.

The end point of the converter blow is determined by the eye as in the usual converter practice, then the molten ferromanganese added in the required amount brings the carbon and manganese to the desired percentage in the metal. The same is true of the open-hearth process except that the carbon content of the metal in the bath is determined before pouring by the usual method of pouring a test piece and fracturing it to observe the character of the fracture.

Pour Over the Lip

When manganese steel is poured from bottom-pour ladles, nozzles from the smallest size to as high as 3-inch or even larger are used. In some foundries all castings are poured over the lip. Owing to the strong cutting action of this class of steel the facing sand must be selected carefully and the best grade of fireclay must be used. Some foundries coat both the green-sand and the dry-sand molds with a heavy coating of silica flour. Even with the strictest precautions castings sometimes burn into the sand of the mold. To free them from the sand the heating furnaces into which they are put after being cast are run with an oxidizing flame about 10 minutes before quenching. This forms a fairly heavy scale of oxide on the castings, which comes off in the quenching operation carrying the sand with it.

As the metal has a high shrinkage severe strains are developed as the castings cool and it is necessary to put them in the heating furnace before they are entirely cold to prevent cracking. Care also is necessary in reheating them not to apply the heat too fast. The high shrinkage of the metal affects the facing of the mold which must be made open enough to yield readily, but yet strong enough to prevent the mold from being washed away during pouring. Similar problems are encountered in providing suitable core-sand mixtures. These mixtures must be free venting and yield readily as the casting begins to shrink.

The heat treating furnaces are of various designs using different fuels. Large flat castings are heated in low-roofed furnaces and handled with cranes. Quenching tanks are located nearby in all cases and some furnaces have the quenching tank so situated that the castings when drawn from the furnace slide down a steel chute into the quenching water. In other cases furnaces for annealing large castings have a large platform covered with firebrick built in front of them. The castings on roller frames are drawn from the furnace upon the platform by the crane using hooks on a chain run through a sheave on the end of the platform away from the furnace.

In other furnaces the car is drawn from the furnace to load and to quench the castings. Fig. 7 shows a car pulled from the furnace and the castings ready to be carried to the quenching tank at the left. It is necessary that the castings be quenched as quickly as possible after being drawn from the furnace. Therefore, the quenching tanks in all cases are located convenient to the furnace. In this case the castings are piled on a steel skid which rests on rows of brick. These brick are piled so that two rails can be slipped under the skid when the car is pulled from the furnace. The rails both have a steel shackle bolted to each end for the crane chain to be hooked to, as indicated at *D, D*, Fig. 7. In this illustration the rails have been inserted by the men wearing asbestos clothing. Their bodies are covered by shirts, their hands by gloves and their heads by hoods. This enables them to get quite close to the steel, but they must work as rapidly as possible so as not to remain near the hot charge longer than absolutely necessary. To expedite the work five men are in the gang. One who is not dressed in asbestos hands the chains to the four men dressed in asbestos and each connects one chain to a shackle. It also has been found beneficial for the men to wear respirators on account of the noxious gases coming from the furnace when it is opened.

Cast Iron Hubs Blow Off Steel Inserts

Question—We are having some trouble in securing sound cast-iron hubs on fan blast wheels in which six small steel tees project into the casting. Would tinning the ends cure the trouble or do you know of any cheaper process than tinning.

Answer—Where large quantities of castings of this or a similar character are made, tinning that part of the surface that comes in contract with the molten iron, is the cheapest and most satisfactory method. Usually the manufacturers of small pipe fittings are equipped for doing that kind of work and the additional cost for tinned fittings over the plain variety would be trifling. For small quantities or where it may be preferable to prepare the tees locally the ends may be dipped in water glass. This material, silicate of sodium or potassium, or both, is sold in the shape of a stony powder and is dissolved in water. The parts to be treated are dipped in this solution and dried before they are placed in the mold. Irrespective of what material is employed to coat the inserts it is necessary that they be absolutely dry before they are placed in the mold and what is just as important, they must not be placed in a mold formed of hot or even warm sand. Usually molding sand is cold before it is used, but occasionally it is used while still warm. While in this condition it is perfectly satisfactory for making a great variety of molds, but it cannot be used for making molds in which metal inserts are employed. The steam from the hot sand, be it ever so little, will condense on the metal insert and cause blowholes in the casting. Again, where tinned metal parts are carried in stock it is advisable to dry each day's supply before the parts are distributed to the molders. The stock room may be damp and a sufficient quantity of atmospheric moisture may have condensed on the parts to render them dangerous.

The Whiting Corp., Harvey, Ill., has moved its New York office from suite 310 to suite 311, 136 Liberty. J. Ross Bates, vice president and eastern export sales manager is in charge. He is assisted by D. Ploderman.

French Set Up Foundry School

Comprehensive Plan Launched To Provide Thorough Preparation for Foundry Engineers and Managers—Degree of Engineer in Foundry Practice Granted—School Is Linked with Apprenticeship System

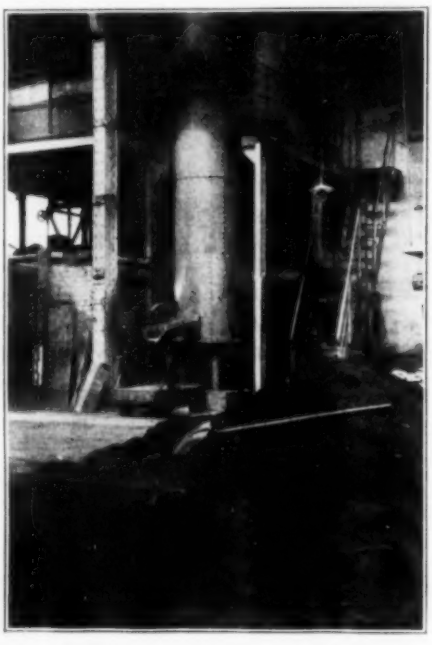
BY VINCENT DELPORT
European Correspondent of THE FOUNDRY

WHAT is said to be the first school established in France for the purpose of training engineers specially for foundry management was opened in Paris on Jan. 7, 1924. It is called the *Ecole Superieure de Fonderie* and is located in the buildings of the *Ecole Nationale des Arts et Metiers* where the International Foundry congress was held in September, 1923. The creation of this school marks the culmination of a campaign which has been carried on for three years by the *Syndicat General des Fondeurs de France* for the purpose of increasing the supply of French foundry specialists from the skilled molders up to engineers and managers. This work has been carried on with the aid and approval of the French government, and the *Association Technique de Fonderie de France* has also given its support to the enterprise.

The idea of a special school for foundry engineers was originally developed by E. V. Ronceray, chairman of the French committee for training and apprenticeship, in a paper which was read at the foundrymen's congress of Liege, Belgium, in September, 1921. This paper was entitled, "Apprenticeship and Professional Teaching in the Foundry Practice." The question was taken up in France by the Syndicat General des Fondeurs de France whose president is G. Dufour, a foundry proprietor. The government gave its support to the scheme through the channel of the department of education, and M. Labbe director of technical education was delegated to keep in touch with the Syndicat des Fondeurs. It was agreed that if the program of the Syndicat were accepted, the ministry would share in the financing of the enterprise to the extent of one-half the cost, the other half of the funds being furnished by the Foundrymen's association; furthermore, the necessary lecture rooms, the foundry, and the pattern shop of the *Ecole Nationale des Arts et Metiers* of Paris were to be put at the disposal of the new institution. On July 30, 1923, the scheme was definitely laid out by the *Syndicat General des Fondeurs* and communicated to the representative of the government. At the beginning of October, the names of the proposed directors of the future school were drawn up for approval, seven members of the board being designated by the *Syndicat des Fondeurs* and six by the *Ministere de l'Instruction Publique*, and on Oct. 23, the decree was signed authorizing the opening of the school with the president of the *Syndicat General des Fondeurs* as chairman of the board ex officio. The administration of the school is delegated to the director of the *Ecole Nationale des Arts et Metiers* of Paris, M. Corre.

Thorough Instruction Planned

The number of students is limited at present to 50; they are admitted after a competitive examination of all the candidates. Foreigners and special students can be admitted providing they do not exceed 20 in number. At the opening of the school there were 18 students, including one foreigner and one special student. Regular students pay a fee of 500 francs (about $25) for their year's studies; foreign students and special students pay 1000 francs (about $50). The working capital of the *Ecole Superieure de Fonderie*, which is organized as a corporation, is 80,000 francs furnished by the government and by the Syndicat General des Fondeurs, each sharing equally. The course of study is comprehensive and in fact represents the last stage in the training of the foundry engineer or manager following his apprenticeship.



IN ADDITION TO THE CUPOLA THE SCHOOL FOUNDRY HAS OTHER TYPES OF MELTING FURNACE

The general method which is followed can be summarized as follows: Apprentices are taken in certain foundries, usually between the ages of 13 and 16; during the first year they are given elementary notions on general subjects during one or two evenings a week; this constitutes the general preparatory course. During the next two years, the apprentices and also grown up workmen who are willing to do so, follow a course of professional training. This course, which constitutes the first degree, is given in the various districts of the country wherever a number of foundries are grouped together. This preliminary course consists of lectures delivered in the evenings according to a program laid down by the *Syndicat General des Fondeurs*. At the end of this period, the apprentice who has at the same time been trained practically in the foundry, has become a qualified workman. If he wishes to improve himself, he then follows for one year a higher course which constitutes the second degree in his training as a specialist. This higher course is also given in each separate district and generally takes the form of Sunday lectures and exercises. Thus the student becomes familiar with the elements of mathematics, physics, chemistry, drawing, etc. This complete system of instruction is not yet fully developed but the program is laid out and efforts are being made toward its realization.

The workman has now been trained for three or four years. He may be employed in one plant or another. In fact at any time he may choose not to pursue his studies and to remain in the ranks. But should he decide to reach the last stage and apply for admission to the *Ecole Superieure de Fonderie*, he will have to follow a final preparatory course for one more year. This course is given at the various local professional schools, twice a week in the evenings,

and prepares the student for the examination which he will have to pass in order to be admitted to the superior foundry school. This examination consists of both theoretical and practical tests.

Candidates for the *Ecole Supericure de Fonderie* come from two sources: The foundries themselves as just described, and the leading engineering schools. Each of these sources may furnish as much as 50 per cent of the number of regular students. Until further notice candidates coming from certain recognized engineering schools must have had one year's actual practice in a foundry; then they submit to the practical examination and are exempted from the theoretical part. The other candidates only submit to the theoretical tests. The object of the examination is not only to eliminate candidates in excess of the fixed number, but also to be sure they have sufficient knowledge of mathematics, physics, chemistry, drawing, etc., on the one hand, and of foundry practice on the other to enable them to follow the course with profit. The course lasts one year, from Oct. 1 to July 14, half a day being devoted to the lectures and exercises, the other half to the student's personal studies.

The course of the study consists of 160 lectures on a variety of subjects, practical and theoretical, pertaining to foundry practice, and 70 practical exercises comprising laboratory work and actual practice in the foundry and pattern shop. During each lecture a certain amount of time is devoted to discussion during which the students can obtain explanations on points which have not been well understood. They also are quizzed by the professors on the subject of the lesson. Each week the students visit a foundry plant, and once a month they report on these visits. At the end of the year's work, the regular students choose a subject on which they write an essay or thesis. They are then examined on the whole course, but principally on the subject they have chosen for their thesis. This examination serves to classify the students as they come out of the school. Their answers to the questions put to them during the lectures and their reports on plant visitations also serve to classify them. Those who have passed all the various tests to the satisfaction of the jury have a right to the title of Engineer E. S. F. A certificate is also delivered to the special students who have followed the course regularly.

The lectures and practical exercises are prepared and delivered by practical foundrymen and recognized authorities

THE COURSE INCLUDES THOROUGH PRACTICAL TRAINING IN PATTERN-MAKING AND THE ECONOMICS OF PATTERN CONSTRUCTION

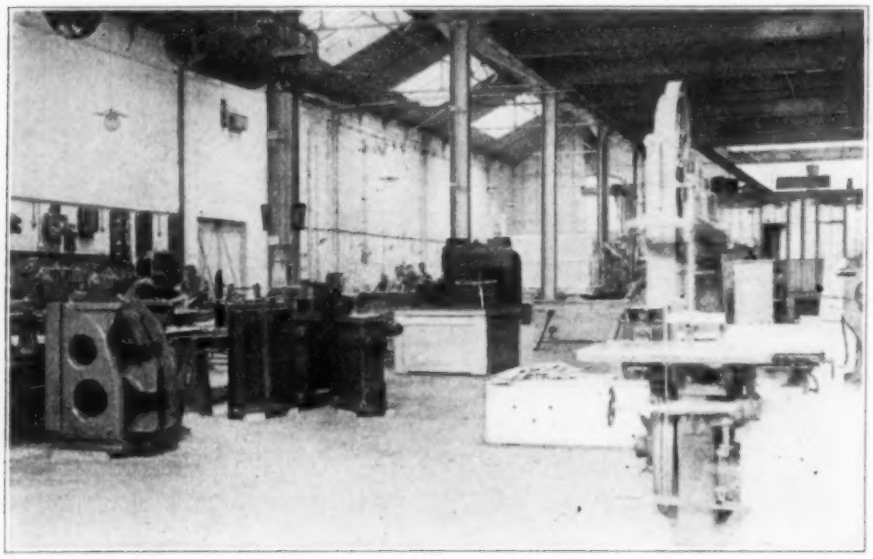
LARGE OVENS MAKE POSSIBLE COMPARATIVE RESEARCHES IN GREEN AND DRY SAND MOLDING

who are specialists in the various subjects. The names of Professor Portevin, E. V. Ronceray, Emile Ramas, Marcel Remy, among others are an assurance that the future foundry engineers will receive a sound education. This attempt, the first of its kind in western Europe to systematize the training of foundry specialists is now beginning to give results which are encouraging for the future.

Makes Semisteel Castings

By G. A. Drysdale

Question: We are endeavoring to make semisteel castings. Our object is to melt the semisteel and regular gray iron in the same cupola furnace, the first two charges of the heat to be semisteel. Could you tell us the proper mixture to use, that is the percentage of pig iron, cast iron scrap and steel scrap, also the chemical analysis that should be contained in the different ingredients. We are endeavoring to make castings for ice machines and ammonia fittings.



METAL PATTERN CONSTRUCTION ALSO IS STUDIED IN ALL ITS BRANCHES

Answer: In making semisteel castings the chief object is to secure a close uniform grain. They should be strong and tough and yet easily machinable. Two good average semisteel mixtures for such a purpose follow:

FIRST SEMISTEEL MIXTURE

	Per cent silicon	Per cent sulphur	Per cent Phosphorus	Per cent Manganese	Per cent charge
Pig iron ...	2.500	0.035	0.500	0.650	45
Return scrap, etc	1.850	0.090	0.350	0.500	45
Steel scrap..	0.050	0.040	0.030	0.500	10
Average analysis	1.960	0.060	0.385	0.567	100

SECOND SEMISTEEL MIXTURE

Foundry pig iron No. 1	4.000	0.025	0.400	0.500	30
Foundry pig iron No. 2	2.060	0.030	0.300	0.750	20
Return scrap, etc.	2.000	0.090	0.350	0.500	30
Steel scrap..	0.050	0.040	0.030	0.500	20
Average analysis	2.210	0.048	0.291	0.555	100

The cupola mixture composed of pig iron, return scrap and steel scrap should be of such a combination as to bring the resulting semisteel castings or test bars within the following chemical limits. Silicon 1.80 to 2.10, sulphur not over 0.120, phosphorus below 0.500, and manganese should be 0.5 to 1.00. The amount of pig iron, return scrap and steel scrap to use per charge will depend upon their respective chemical composition. The average analysis of the above two mixtures runs approximately from 2.00 to 2.20 per cent in silicon and when melting in the cupola furnace it is customary to allow an oxidation of from 0.10 to 0.20 per cent.

The sulphur in the resultant castings will average from 0.02 to 0.05 per cent higher because iron has a strong affinity for sulphur and takes up approximately this amount from the coke with which it comes in contact in melting. The phosphorus remains approximately the same, but the manganese content in the casting is considerably lowered through the tendency of this element to mix with the sulphur in the molten iron. Part of this sulphur has been absorbed from the fuel as noted. The sulphur and manganese together form the compound manganese sulphide which to a certain extent is absorbed and carried away in the slag.

The average American pig irons usually are rich in carbon, and the percentage of combined and graphitic carbon in the castings will be governed by the chemical and physical conditions at the time of pouring. In other words, the time occupied by the metal in solidifying is governed by the size of the casting, whether it is heavy, medium or light. Further, it depends upon whether the mold is green sand, over dried or baked. To make satisfactory semisteel castings, knowledge of such physical conditions are required and are just as essential as the care to be exercised in making up the cupola mixture. Practically any kind of mild steel scrap may be used in the cupola mixture, but extremes in size should be avoided. For example, large pieces of boiler plate, falling horizontally into the cupola, may interfere with the passage of the blast, and extremely small sections of steel scrap which have a tendency to fuse together may cause the same effect.

The usual method of charging a cupola furnace for semisteel is to distribute the pig iron as evenly as possible, close to the sides of cupola. Then add the steel scrap at the center with the return iron on top.

Lead Coating for Wire Drawing Dies

Question: We cast wire drawing dies in iron molds and use foundry lead mixed with alcohol for a mold wash. The lead seems to become lumpy and the bottom of the die is not as smooth as it should be. We will appreciate any information on a more suitable material to employ for this purpose.

Answer: Provided you are using a satisfactory grade of lead we see no reason why the surface of the casting should present a lumpy appearance. In our opinion your trouble is traceable to the temperature of the iron and not to the material with which the molds are coated. If the iron is not hot enough it will cover the surface of the iron mold in a series of waves or ridges. Unless iron is extremely hot it will not travel over the face of an iron mold as readily as it does over the face of a sand mold. Iron is a good conductor of heat and rapidly extracts the heat from the iron flowing over it. The result is that as the stream advances the skin almost constantly is setting with the result that the iron piles up behind and then climbs over. You probably are familiar with the fact that surface tension on any liquid will maintain the center at a higher point than the rim. The more nearly the liquid approaches the solid condition, the more marked will be this characteristic. The most familiar example in the foundry is presented while pouring open sand plates. Unless the iron is exceedingly hot and liquid the edges of the plate never will equal the center in thickness.

Charles S. Johnson, formerly sales manager for the Standard Equipment Co., New Haven, Conn., now is general manager of the Standard Radial Blast Corp., 30 Church street, New York. This corporation will hereafter manufacture the radial type sand blast barrels, and also parts for same, formerly made by the Standard Equipment Co.

Studies Growth of Gray Iron

Experimental Work of Moissan with Graphite Reviewed and Theory for Growth of Cast Iron Under Repeated Heating and Cooling Is Evolved —Graphite in Iron Absorbs Gases

BY T. E. HULL

GRAY cast iron may be defined as an alloy of iron and carbide of iron, with minor other metals and metalloids,, holding graphitic carbon in suspension. The metal itself takes up a reasonable volume of occluded gas in the process of solidification, and this also is the case to a marked degree in the formation of graphite in contact with metals, as has been demonstrated by Moissan. It is now definitely agreed that the elements silicon and carbon, and the occluded gases to a somewhat larger degree, are the most important factors in the phenomenon of growth in gray iron. While phosphorus and its distribution is a contributory cause to a much lesser degree, it is now established as having probably the more important influence in the production of cracking of cast iron under heat. Phosphorus combines with the iron to form a phosphide which is soluble in iron to the extent of 1.7 per cent, forming a saturated solid solution. Beyond this percentage free phosphide separates out and forms a eutectic. Phosphorus also forms another eutectic with the carbide of iron. These phosphide eutectics possesse comparatively low melting points; they usually segregate in fringes in the metal which are easily discovered as giving white areas in the microscopic examination of the iron.

Phenomena of Growth

A. E. Outerbridge who did pioneer work in the study of grain growth, in an article published in the *Transactions* in the American Institute of Mining Engineers (1905) describes tests in which the bar was heated to 800 degrees Cent. and says that increase in volume of the cast-iron bar is unaccompanied by any change in weight, and hence deduces the argument that the phenomena of growth is due to inter-molecular rearrangement.

In more recent experimental work, undertaken by H. C. H. Carpenter to substantiate these figures, it was found that if the heating is sufficiently prolonged a growth will take place at much lower temperatures. Cast iron valves, subjected to superheated steam at 400 to 600 degrees Fahr., increased in size permanently, although it must be noted that these steam valve castings are also subject to another factor, namely high pressure, which would greatly accelerate growth.

Silicon Most Prominent Factor

Silicon which exists in the iron as iron silicide is undoubtedly the most potent factor in causing maximum growth. The iron silicide under repeated heating and cooling becomes oxidized and changed to a disintegrated mass of iron oxide and silica increasing in volume. Some metallic iron is also oxidized, the amount depending upon the distribution of the graphite and the consequent avenues for oxidizing gases, also the time and temperature factors in the process of heating and cooling.

Graphitic carbon is essential to growth in an indirect way by providing passages for oxygen. The coefficient of linear expansion of graphite is 0.00000786 at 40 degrees Cent. and of iron 0.0000118 from 0 degrees to 100 degrees Cent. This dissimilarity of the coefficients of expansion of iron and graphite largely accounts for the deterioration of cast iron under conditions of heating and cooling. The gases so heated penetrate the iron along the graphite flakes which have a much smaller coefficient of expansion than that of the iron. These graphite flakes are deformed and easily broken up opening further avenues for oxidation to be effected. Thus by alternate heating and cooling the spaces of the graphite flakes are developed admitting of the further penetration of oxygen.

The researches of Henri Moissan of the University of Paris in the production of artificial graphites by simple rise of temperature in various metals is of real use to the study of graphite in iron. Moissan found several varieties of graphite, as there are of amorphous carbon, with densities varying between 2.10 to 2.25. All burn in oxygen freely at 660 degrees Cent. The stability of graphite increases with the temperature to which it has been subjected. This reveals itself in the greater or lesser resistance offered to the conversion into graphitic oxide, while as the melting point of the metal in which the graphite has been formed rises, the resistance offered to oxidation plainly increases.

Moissan also has found in a study of iron graphites produce at a temperature of 1150 degrees Cent. that the whole of the free carbon in cast iron is not existent as graphite, but is a mixture containing amorphous carbon. Moreover differing varieties of graphite are obtained from one and the same metal under varying conditions of temperature and pressure; thus we are lead to the conclusion that the temperature attained in the production of the iron and the rate of cooling in the molds exerts important influences on the quality and disposition of the graphite. The iron graphite so obtained gave on analysis a percentage of hydrogen varying from 0.15 to 0.80 per cent. The experimenter also found that this graphite contains nitrogen. This experimental production of iron graphite was under much more elevated temperature influences, obtaining a graphite of increasing fineness of crystal, of a purer quality, and possessing greater stability toward oxidizing conditions.

Silicon Retards Growth

The extensive research of Moissan led to the following conclusions:

All the graphites he examined contained hydrogen. This hydrogen results either from a physical phenomenon or condensation of gaseous hydrogen in graphite, which view Cailletet supported long ago, or from chemical action.

The presence of combined carbon has been found to be of almost a negligible factor in the process of growth, while the presence of manganese modifies the action of silicon, because graphite formation is hindered, and consequently the rate and amount of growth is retarded by its presence.

A variety of opinion exists among investigators regarding the effect of this phosphide eutectic upon growth. The author's opinion is that while the presence of phosphorus is not an important factor in growth it is important under temperature influences in producing disinte-

Paper read before the West Yorkshire Metallurgical society. The author is engineer, J. Hopkinson & Co., Ltd., Huddersfield, England.

gration and deterioration. It must always be remembered that at a dull red temperature the phosphide eutectic is near its melting point, and if softening or liquidation does happen cracking will be more apt to occur. In the production of pistons, etc., for internal combustion engines the avoidance of this latter trouble may be assisted in the provision of a low-phosphorus iron.

Phosphide Areas Are Target

From the study of frequent failures of cast iron under high pressures and superheated steam it is concluded that the presence of the phosphide areas presents an easy target for attack leading to the elimination of the eutectic and leaving to microscopic view the empty cavities.

The increase in weight in the iron accompanying its growth is resultant of the process of oxidation, the metallic iron being converted into nonmetallic oxide. The net increase in weight is the result of oxidation of the silicon and iron, less the carbon oxidized to a carbon dioxide gas.

All metals contain comparatively large volumes of occluded gases and it is indisputable that these imprisoned gases play an important part in the question of growth. Gray cast irons absorb unreasonably large volumes of gases, chiefly hydrogen, nitrogen and carbon monoxide, during the process of melting. This is especially true when the iron is melted in the cupola.

It is interesting to note that Moissan's experiments were conducted in the ideal metallurgical atmosphere of the electric furnace, which must tend to convey to the metal and to the graphite segregate the minimum of gas occlusion. Moreover, Moissan has shown that all graphites obtained from a liquid metal at a high temperature, whether by a difference of solubility, or by chemical reaction, have the property of swelling readily when heated to dull redness, which swelling is attributed to a sudden evolution of gas. The graphites produced under high temperature influences swell at temperatures varying between 165 and 175 degrees Cent.

Through the agency of these imprisoned gases in the iron in its original cast condition, the process of repeated heatings would set up an internal pressure of gas which can only be liberated at the boundaries between the solid solution and the graphite. By this means the gases exercise a purely physical function which of itself will contribute to growth, but facilitates the chemical changes which affect the whole structure.

The general influence of gases on growth appears to be important and actually the first step in the disintegration of cast iron under the conditions of frequent heatings and corresponding coolings.

It is interesting to note that steel under microscopical examination shows two structural constituents, ferrite or pure iron, and pearlite, a eutectoid of ferrite and carbide of iron. The coefficient of expansion of these two constituents are almost identical, while they are both mechanically strong. Rolled steel on being heated and cooled a large number of times, shows a tendency to contract slightly.

It has been suggested that the reason of the shortening of the rolled mild steel was that the elongated grains of the steel produced in rolling, assumed a normal round shape again on reheating, and thus contracted in length. It is interesting to note that cast steel which has not been subjected to rolling, does not appear to have this tendency.

It may be asked how it is that in the face of the many failures of cast-iron steam valves, chests, pipes and superheaters, the cast-iron engine cylinder and more especially the liners and pistons of the internal combustion engine survives. The answer is probably that the film of lubricant, to which the face of the piston and cylinder is always subjected, has protected them. The entrance of lubricant under the influence of heat and gas pressure into the interstices of the grains by way of the graphite plates proves troublesome, in the preparation of microsections from such faces, which persistently show the presence of lubricant even after careful cleaning.

A summary of the chief factors at work in the growth of cast iron, in the writer's opinion, would be tabulated in the order of their importance as follows:

The oxidation of the silico ferrite and the consequent expansion of the products of oxidation must account for the major increase in bulk of the iron in the early stages of growth.

The occluded gaseous constituents of the iron are no doubt the prime factor in the *early* growth of the metal, in reality the starting point, being liberated under pressure, causing the deformation of the graphite crystals and opening up suitable avenues for their removal.

The element phosphorus and its distribution, while being a contributory cause of growth to a small degree is no doubt largely responsible, when present in sufficient quantity, for the production of the cracking and the break up of the material under these influences.

In cases approaching the total expansion, the free iron is oxidized and accounts for maximum growth.

Castings required to withstand the severe conditions of the internal combustion engine made of synthetic cast iron as produced in the electric furnace would go a long way to mitigate many difficulties encountered. The electric melting process is metallurgically preferable to any cupola practice in every respect, while the composition of the resulting iron is variable at will, giving easy control of those elements which are the important factors in growth.

The disposition of the graphite in cast iron when produced in the electric furnace is as small crystals in the case of low total carbon, in contradiction to the commonly occurring form in cupola iron, namely, elongated flakes. An iron produced synthetically is of smaller grain size, mechanically stronger and of a softer nature for machining in spite of its lower carbon and silicon content.

Book Review

Sand and Crushed Rock; by Alfred B. Searle; in two volumes, cloth, 756 pages including 51 index pages, 8¼ x 5¼ inches, published by Henry Frowde and Hodder and Stoughton, London, and furnished by THE FOUNDRY, Cleveland for $17.50 net.

This work is intended to summarize in a convenient form such geological, chemical and mineralogical information on sand as is of value to those engaged in the production, sale and various uses of this material. Attention has been paid to the properties that are desirable and those which are harmful in sands used for various purposes. Volume I describes at length the geological origin of sand, and the various means by which sand has been formed. Volume II deals with the various uses of sand for the industries such as in concrete, road construction, metallurgy, refractory materials, enamelling, pottery, including glass making and abrasives. Several chapters are devoted to molding sands, giving the properties desired, the preparation, chemical composition, texture, and uses of this class of materials. Suggestions are offered for artificial bonding, and for making suitable molding sand mixtures for different purposes. A number of illustrations are used including micrographs, and tables. Through the entire work simple language has been maintained so that it may be understood by all those engaged in the industry.

Plans have been completed for the erection of a new administration and office building for the Carborundum Co. at Niagara Falls, N. Y. The building will be 200 feet long, 62 feet deep, with three stories and basement and will cost approximately $300,000.

Records Show Cupola Control

Constant Personal Check Must Be Kept on Materials and Methods Otherwise Records Are Liable To Have Little Value—Scales and Weighing Methods Require Particular Attention

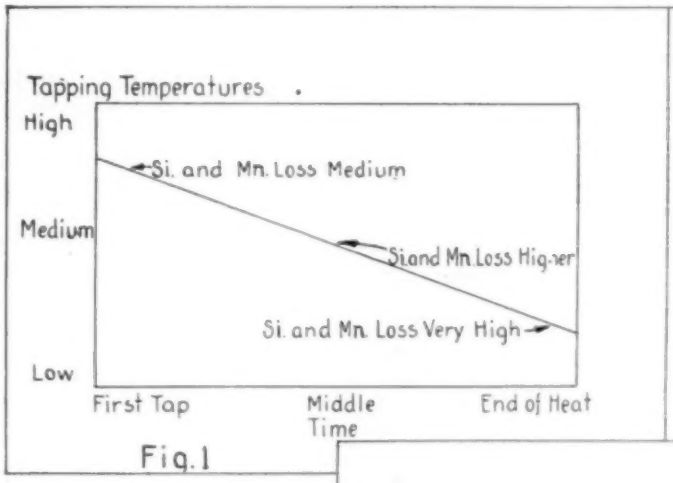
BY S. J. FELTON

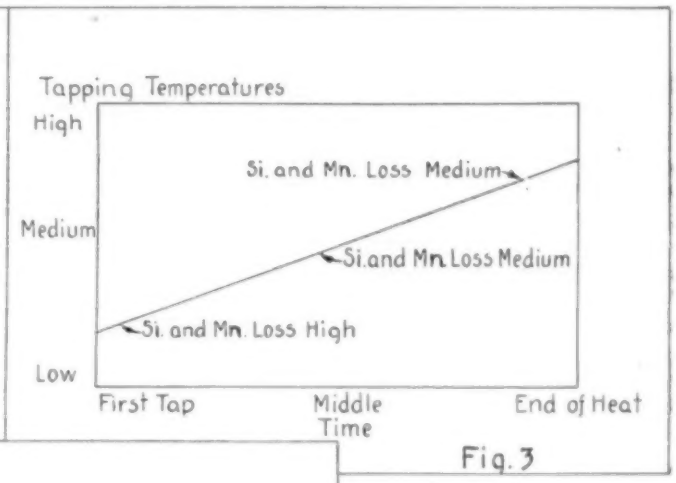
COMPLETE tangible records must be kept and utilized for the maintenance of uniformity in any process subjected to variables from day to day. This feature is illustrated in the wide spread use of business charts and records covering practically every form of human endeavor. On account of the many variables incident to melting iron in a cupola some form of permanent daily record should be tabulated and later consulted for guidance in subsequent operations. Satisfactory results have been secured from the record forms shown in the accompanying illustrations.

For a period extending over nearly two years the author melted iron which had to conform to such exacting specifications that iron from each tap was analyzed. The metal was melted in a number of cupolas situated in various parts of the country and as a result a considerable volume of valuable data was collected showing the effect of variation in cupola practice on the uniformity of the iron. The numerous analyses automatically became part of our general cupola record and led to the adoption of a method for controlling the loss in silicon and manganese.

Relative tapping temperatures are plotted against time in the hypothetical curve shown in Fig. 1. The silicon and manganese losses are supposed to have been obtained by analyzing three separate samples taken from the mixing ladle respectively at the beginning, the middle and the end of the heat. The actual analysis and the calculated analysis are compared. The chart indicates that the temperature of the iron at the start was above normal but it dropped steadily throughout the duration of the heat. The loss in silicon and manganese was medium at the first part of the heat but gradually and steadily became higher until they reached the maximum at the close of the heat.

Assuming that other operating conditions were normal the curve indicates that the bed was one proper height, but the intermediate coke charges were too light and as a result some iron had dropped to a point below the carbon dioxide zone toward the close of the heat. The high oxidation loss also confirms this view. Reasoning along somewhat similar lines a study of the curve in Fig. 2 indicates that the coke bed was satisfactory, but extremely heavy intermediate coke charges were placed in the cupola afterward. The melting speed was retarded considerably in both cases and without a chart one might find it difficult to decide whether too much or too little coke had been used.





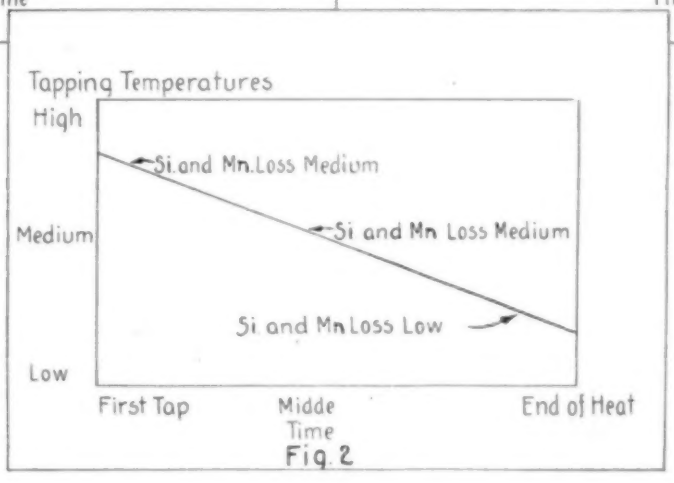


FIG. 1 ABOVE—RELATIVE TAPPING TEMPERATURES PLOTTED AGAINST TIME SHOW INCREASING LOSS IN SILICON AND MANGANESE FROM THE PERIOD OF THE FIRST TAP UNTIL THE HEAD OF THE HEAT

FIG. 2—LEFT—CURVE INDICATES THE COKE BED SATISFACTORY. FIG. 3—ABOVE—THE CHART INDICATES THAT THE BED WAS LOW, BUT SUBSEQUENTLY WAS BUILT UP BY INCREASING COKE CHARGES

The author, S. J. Felton, is instructor in metallurgy and mechanics at Ohio Mechanics' Institute, Cincinnati.

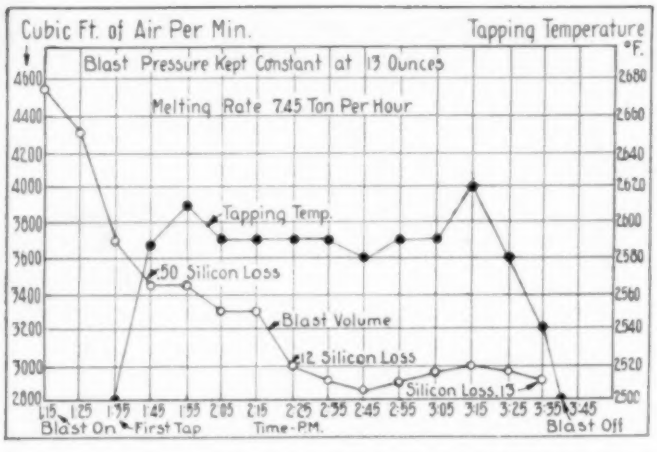


FIG. 4—THE PRESSURE WAS MAINTAINED AT 13 OUNCES, BUT NO ATTENTION WAS PAID TO VOLUME

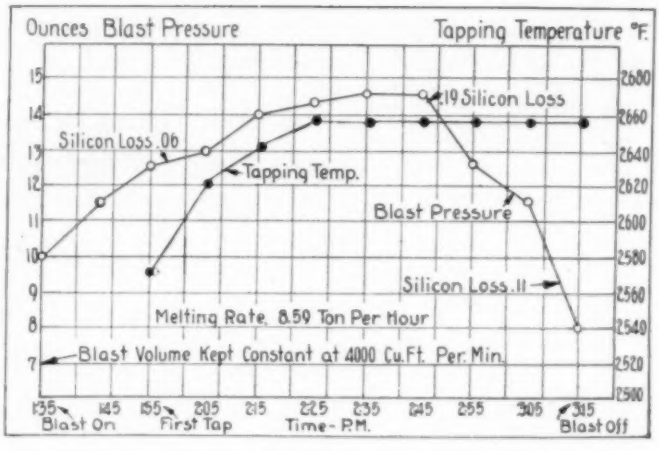


FIG. 5—RESULTS OBTAINED BY MAINTAINING CONSTANT VOLUME WITH VARYING PRESSURE OF BLAST

The relative losses shown on the two charts indicate definitely the condition under which the iron was melted in both cases.

The chart shown in Fig. 3 indicates that the bed was low, but subsequently was built up to a proper height by a slight excess in the quantity of each intermediate coke charge. A cupola heat taken under practically any variation of operating condition may be demonstrated in a similar manner. Variation will appear in the silicon and manganese loss in any normal heat, but stack conditions usually may be detected and remedial measures applied on the following heats. This is particularly true when these losses are considered in comparison with other cupola records. Interpretation of the cause of silicon and manganese loss is complicated to some extent by stack conditions.

Silicon Losses Recorded

Part of the record of a heat melted in a cupola lined to 48 inches inside diameter is shown in Fig. 4. A meter for recording the volume recently had been attached to this cupola, but the cupola tender was allowed to operate the cupola by the pressure gage in the manner to which he had been accustomed so that these data might be secured. The blast pressure was maintained at a constant pressure but it may be noted that the volume started above 4500 and dropped steadily until it registered 2900 cubic feet per minute at the end of the heat. The tapping temperatures were low at the beginning and end of the heat and not any too high in the middle. The amount of silicon losses, indicated on the chart were obtained by analyzing separately three samples from the mixing ladle at different periods during the heat. The silicon loss alone is given because usually it is sufficient for the purpose. Occasionally it is advisable to also determine the loss in manganese.

Evidently the high blast volume at the start raised the carbon dioxide zone above the bed. This is indicated by the high silicon loss in the first sample. The blast volume dropped so low for the remainder of the heat that it is doubtful whether or not a connected carbon dioxide zone existed. The fact that the volume increased somewhat toward the end of the heat without materially affecting the silicon loss indicates that a sufficient quantity of coke was employed between the charges of iron.

Record of another heat in the same cupola is shown in Fig. 5. In this case the blast volume was maintained at a constant figure throughout the duration of the heat. The record indicates that this was a more satisfactory heat. The tapping temperatures were high and uniform except at the beginning. The initial low silicon loss may be regarded as evidence that the coke bed was too high. The cupola tender had been accustomed to placing a high bed probably in an unconscious effort to offset the effect of a high blast volume at the start. This was due to relying altogether on the pressure gage.

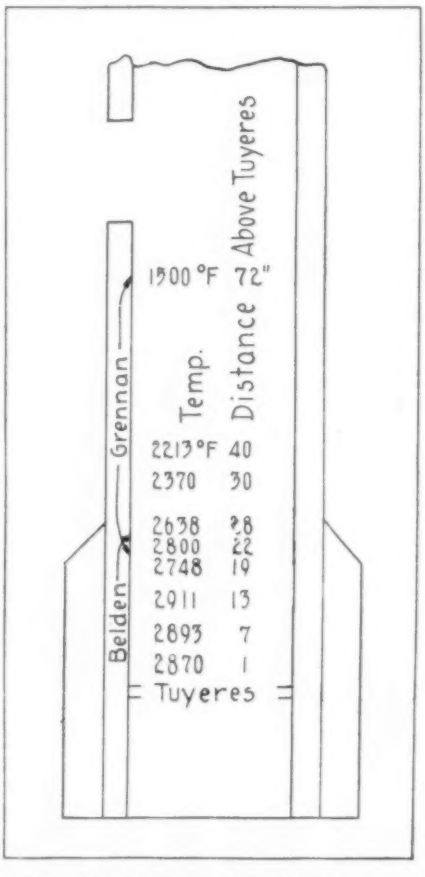


FIG. 6—TEMPERATURE RANGES IN THE CUPOLA

However, when depending on the volume meter it has been found advisable to put in a heavy bed and increase the volume by about 200 cubic feet per minute above the rated amount at the beginning of the heat. The relatively larger quantity of metal melted quickly, heats the stack. The melting rate indicates coke was used to moderate excess. Sometimes foundrymen are tempted to save coke by cutting down the ratio between coke and iron. This is a dangerous practice and in this instance no increase in tapping temperature could be expected as the temperatures shown practically are the maximum obtainable melting ordinary gray iron.

Not a Cure All

The foregoing does not necessarily prove that all heats in which the blast is controlled by pressure gage readings are in the same class as the heat recorded in Fig. 4. Uniform, satisfactory heats have been produced where the pressure was maintained constantly at the same point. The temperature of the iron was high and did not vary more than 20 degrees Fahr. at any time from the first tap to the last.

Keeping the blast volume constant is not necessarily a cure all. Changes in pressure cause variation in the quantity of oxygen delivered and probably affect the position of the carbon monoxide zone. The relative silicon loss compared with the pressure curve Fig. 5 seem to bear out this statement. The graphs shown in the various illustrations

form only part of the heat records. The complete record includes data on the charge, weather conditions, pouring characteristics, percentage defective castings, general observations, etc.

Charging platform scales require constant care and supervision. Scales are not yet made which can withstand the heavy duty incident to a charging platform for any great length of time without frequent attention and repairs. As an extreme instance of the necessity for close supervision, men on the platform have been known to pick scale weights out of the scrap and substitute them for the proper weights lost through carelessness. Different scales are designed to operate with different leverage control and the weights designed for use with one scale certainly will not present an accurate reading when used on another scale.

In using the record forms illustrated or others of a somewhat similar character it is advisable to test new coke shipments by placing some on the last three or four charges and observing the results on the graph. In this manner the old and new coke may be compared and the amount required readily may be estimated.

Cupola Temperatures

As some of the interpretations of these records are based on theories of cupola reaction which previously have been presented*, it may not be out of place in the light of recent research to recapitulate. These theories are based on the assumption that a high melting point in the charge is compensated for by melting higher in the stack, thus affording the molten iron an opportunity to pick up additional heat in the long drop through the hot zones. Coke in moderate excess used as a safety factor in connection with a high melting point charge, results in a lowering of the melting point on account of the time element; but melting takes place higher in the stack with the same compensating features just mentioned. This theory is based on 13 years cupola experience during which on many occasions it was observed that cupolas with uniformly high tapping temperatures were the rule in spite of variables incident to the process. An almost amazing uniformity in the tapping temperature is shown in Fig. 5 which certainly suggests there is some compensating features in the stack.

In developing this compensating theory the work of Belden* was utilized in an effort to predict that temperatures were sufficient to cause melting high in the stack. Grennan's* valuable work later has shown that such temperatures are found in the stack. The average results obtained by these investigators are shown graphically in Fig. 6. The chart shows the various temperatures in a cupola from the tuyeres to the charging door. Undoubtedly previous conceptions of cupola temperatures have been too high. Richards* shows that if coke was considered pure carbon and heated to the maximum temperature before it burns (by the combustion of the preceding part) and if complete combustion occurred without excess air the maximum temperature attained would be 3990 degrees Fahr. A reasonable assumption would be that in a cupola using commercial coke and excess air the temperature would be lowered approximately to that shown in the illustration.

Grennan's tests indicate that the size of the pieces of iron composing the charge influences the height at which the metal starts to melt. Observation leads one to believe that in some instances the melting point has more influence in this respect than the size. It is reasonable to expect that the lightest scrap which Grennan mentions as melting highest in the stack, probably was high in combined carbon and thus had a low melting point. At times the author has melted large quantities of boiler plate punchings in the cupola, but invariably on the following day has found many of these small pieces of steel plastered on the cupola lining. They did not melt even though comparatively low in the stack. Results of further tests by Grennan and others eagerly are anticipated by many men interested in cupola reactions.

Open Safety Museum

The American Museum of Safety, 120 E. 28th street, New York, was opened recently. A. A. Hopkins has been made director and is in immediate charge of the work of assembling and presenting specimens of safety devices, materials and equipment.

Consolidation of the American Society of Safety Engineers and the Engineering Section of the National Safety council to be known as the American Society of Safety Engineers, the Engineering Section of the National Safety council, was announced at the banquet following the joint conference of the two organizations in New York recently.

Compare Stoveplate and Machinery Scrap

By G. A. Drysdale

Question: Will you please give us the relative value of machinery scrap and stove plate scrap. Many believe stove plate scrap contains as high a percentage of silicon as machinery scrap although on the market the machinery scrap is sold at a higher price. Also will you please give us the comparative shrinkages. Any information that you can offer on this subject will be appreciated.

Answer: The term machinery scrap is used in rather a broad sense which makes it often vague and confusing. For practical purposes the term means gray iron parts of scrapped machinery. It commonly is divided into heavy and light grades. The chemical analysis of machine scrap approximately is as follows: Silicon 1.50 to 2.50, sulphur 0.60 to 0.125, phosphorus 0.20 to 0.60, manganese 0.40 to 1.00, combined carbon 0.20 to 0.70 and graphitic carbon 2.60 to 3.50 per cent. Heavy machinery scrap usually is much lower in silicon and higher in combined carbon than light machinery scrap. A typical analysis of heavy machine scrap is as follows: Silicon 1.50, sulphur 0.095, phosphorus 0.40, manganese 0.75, combined carbon 0.60, graphitic carbon 2.75 per cent. For light machine scrap: Silicon 2.25, sulphur 0.085, phosphorus 0.50, manganese 0.50, combined carbon 0.30, graphite 3.00 per cent is a common analysis.

The term stove plate scrap is not as broad as machine scrap, but means soft gray iron castings ranging in thickness from 0.125 to 0.50 inch with the following approximate chemical analysis: Silicon 2.75, sulphur 0.80, phosphorus 1.00, manganese 0.50, combined carbon 0.20, graphitic carbon 3.20 per cent.

Stove plate scrap carries a higher silicon and phosphorus content and is a softer and weaker iron than machinery scrap.

Light machinery scrap brings a higher market price than heavy machinery scrap, as the heavy scrap must be broken up before it can be handled conveniently, and charged into air furnace or cupolas. This adds an extra handling expense. Machine scrap has a higher market value than stove plate scrap because the melting loss is lower and the machinery scrap is more easily handled. The average melting loss on machinery scrap ranges from 3 to 6 per cent, and on stove-plate scrap from 7 to 10 per cent. Clean scrap which has been sorted carefully has a minimum melting loss, and oxidized scrap that has not been carefully sorted has a maximum melting loss.

Theorizes on Cupola Reaction, THE FOUNDRY, May 1, 1923.

Bulletin 54 United States bureau of mines.

Visual Observations of Melting in a Cupola. THE FOUNDRY, Nov. 15, 1923.

Metallurgical Calculations, Vol. 1.

Central European Practice

Aluminum Crankcases Molded with Chills and Lugs To Neutralize Shrinkage Effects —Molding Practice Described—Castings Cleaned by Sand Blast and Tested for Porosity by Brushing with Gasoline

BY C. IRRESBERGER

So much already has been published about the construction of patterns for aluminum automobile crankcases, along with data covering methods of mounting these patterns on molding machines, that the relative paucity of information dealing with molding details and especially the arrangement of chills and pegs sometimes is overlooked. These are questions in which every aluminum foundryman is interested. In the hope of contributing something to the literature on this subject the author offers the following notes regarding European practice in the use of chills and pegs on aluminum castings.

Figs. 5 to 9 show various views of an aluminum automobile crankcase, with flywheel cover cast integrally, showing the different chills and also pegs in place. Fig. 5 shows that side of the casting which is faced downward in the mold. It shows the four heavy cast-iron chills I, II, III and IV, which are simply laid on the pattern before shoveling in the sand. Each of the chills I, II and III is provided with two cored holes ½-inch in diameter, which fit over two pins on the pattern thus securing correct position. Fig. 1 illustrates diagramatically how these pins are arranged. Chill IV does not require a pin as it is located sufficiently well by the projection on the casting. By studying Fig. 5, it may be noted that it is the

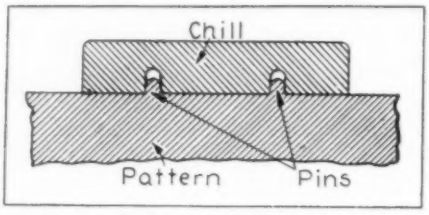


FIG. 1—METHOD OF ATTACHING CHILLS TO PATTERN

purpose of all four chills to densen the spots where the three partitions *A*, *B* and *C* meet the outer wall of the casting and cause a considerable accumulation of material.

How the Stop Pegs Act

Besides the four chills, five pointed pegs, 1, 2, 3, 4, and 5 and two lugs, 6 and 7 may be seen in Fig. 5. These parts serve to hold the liquid aluminum fast. The two lugs, 6 and 7, also serve to concentrate the shrinkage at these points and to fix the casting to the bed of the planer for machining. The liquid aluminum runs over a smooth horizontal mold surface similar to mercury on a pane of glass. It runs over the sand, without sticking to it or wetting it, in the manner necessary to obtain good results and a good surface on the casting. If, however, peg-like holes are made in the mold they will be filled by the liquid aluminum, which then offers a good stop to the aluminum remaining liquid above. The lugs, 6 and 7 as well as the pegs 3, 4 and 5 are molded by means of small projections on the main pattern, whereas the molds for the pegs 1 and 2 are made by hand. For this purpose a cone-shaped piece of wood is stuck into the mold after drawing the main pattern. As it will readily be seen from Fig. 9, these pointed pegs are arranged only on the planes which are horizontal during casting. Such precautions are not necessary on the

FIG. 2—BELOW—DRAG WITH ALL CORES SET—NOTE VENTS EXTENDED THROUGH THE PRINTS, FOUR AT THE SIDE AND ONE AT THE FORWARD END OVER THE FLASK TRUNNION

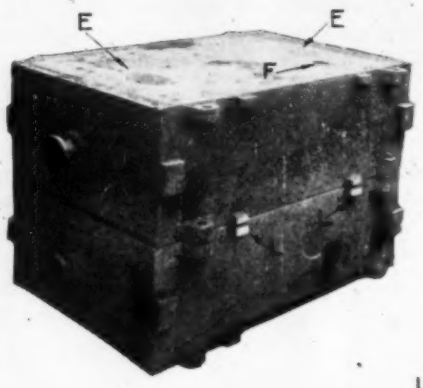


FIG. 3

FIG. 3—LEFT—CLOSED MOLDS SHOWING POSITION OF GATES AND RISER OPENINGS
FIG. 4—BELOW—COPE COMPLETED READY FOR CLOSING—NOTE THE DISPOSITION OF CHILLS BEDDED IN

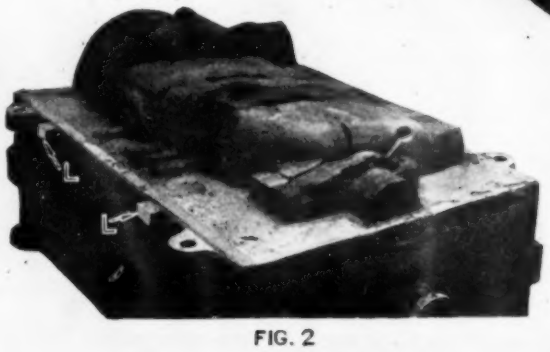


FIG. 2

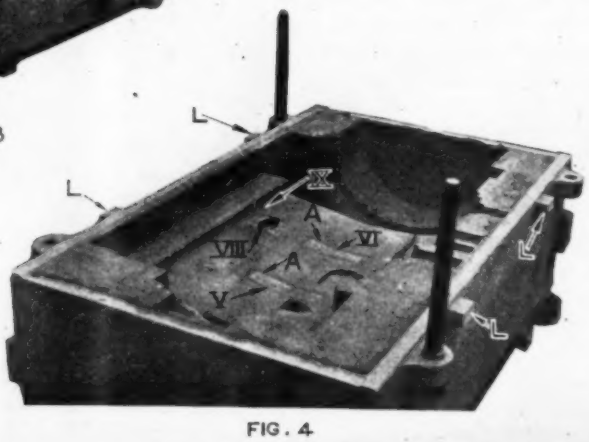


FIG. 4

vertical planes as the metal rises equally and there is no tendency for it to flow away. The mold impressions for the stop pegs must be made before dusting the mold and must be neatly smoothed after dusting by pressing the pattern in again and by repeated turning.

Fig. 5 shows the left side of the casting and its front end at *X*, while Fig. 8 shows the same side with the back end *Y*, which forms the gear ner shap of the casting. However, the projection *G*, Fig. 6 is surrounded by two small chills VIII and IX. A single, ring-shaped chill was tried around this projection, but di1 not give satisfatcory results. The transition from the flat wall of the crankcase to the gear case wall also originally was provided with a chill in the cope as well as at the same point at the drag. It is superfiuous as was proved in repeated experiments the same places as in the drag and a further peg, 9, which has to protect a comparatively large level surface. Also two cylindrical, riser-like sticks, 13 and 14, may be seen. They do not reach up to the outer surface of the mold.

Figs. 6, 7 and 9 show also the arrangement of the gates. The piece is cast from two large runners, *E*, *E*, and there is only one little control-riser *F*, Fig. 6, on the projection *C*. Fig.

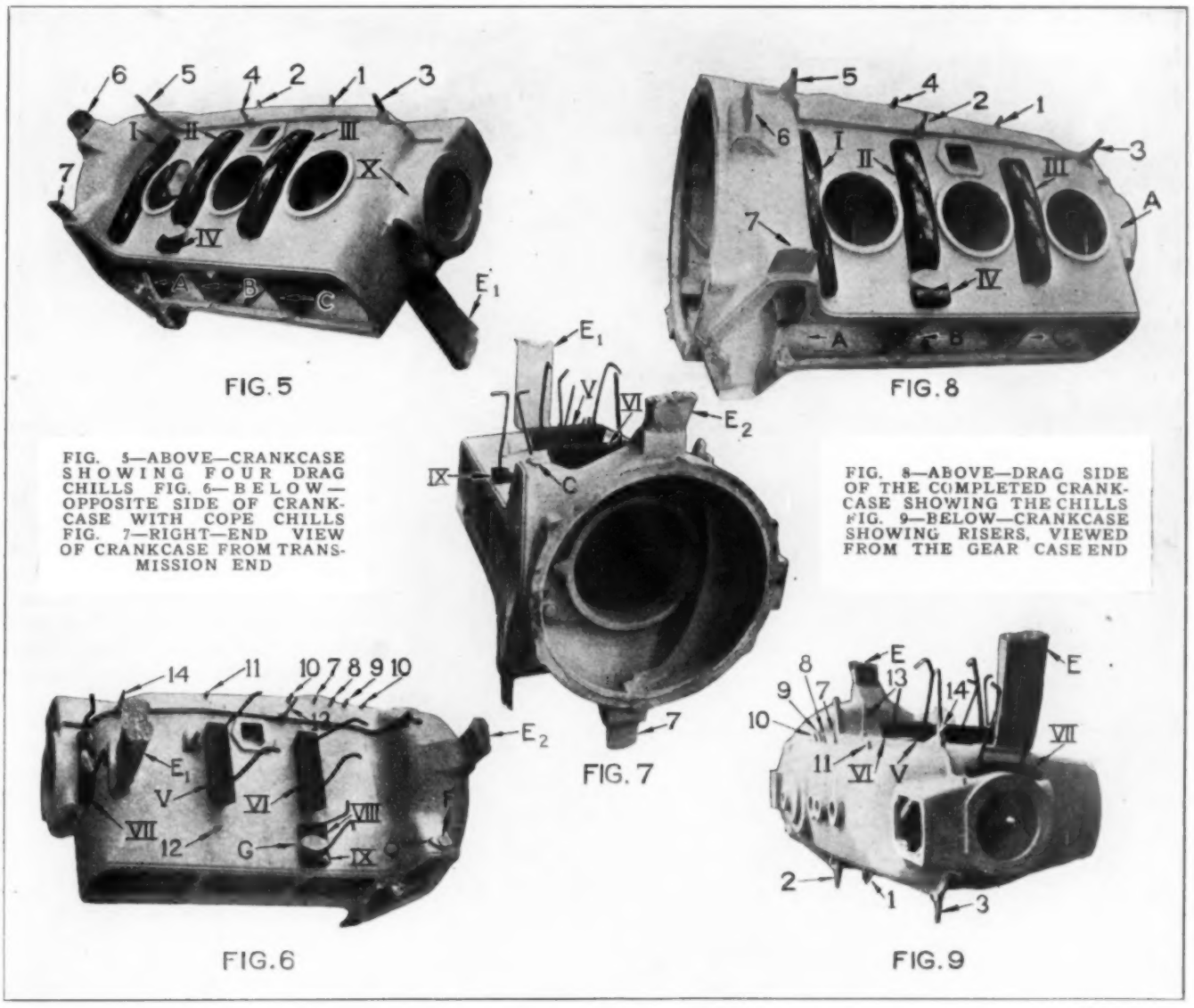


FIG. 5—ABOVE—CRANKCASE SHOWING FOUR DRAG CHILLS FIG. 6—BELOW—OPPOSITE SIDE OF CRANKCASE WITH COPE CHILLS FIG. 7—RIGHT—END VIEW OF CRANKCASE FROM TRANSMISSION END

FIG. 8—ABOVE—DRAG SIDE OF THE COMPLETED CRANKCASE SHOWING THE CHILLS FIG. 9—BELOW—CRANKCASE SHOWING RISERS, VIEWED FROM THE GEAR CASE END

case at the same time. Fig. 7 shows an inside view of the flywheel and gear case.

The arrangement of the chills and the stop pegs in the cope is illustrated in Figs. 6 and 9. Here the chief question is to insure quick cooling at the point where the partitions cross the outer wall of the casting. For this purpose chills V and VI are employed, along with chill VII, which cools the joint at the neck. The two chills V and VI are a little shorter than the corresponding chills I and II in the drag, as is justified by the inand has been discarded. All the chills in the cope are provided with cast-in gaggers as shown which hold them fast in the sand and prevent them from moving.

Fig. 4 shows the cope mold with chills V, VI, VII, and VIII in place. As may be noted the sand border is slicked and blacked a little around the chills. This is done to prevent the sand from falling off after rolling over the cope.

Figs. 6 and 9 show also pegs 7, 8, 9, 10, 11 and 12 on the cope side which have been arranged at about 2 shows a drag with the cores set. The venting of the cores is assisted by means of straw laid in between the flask joints. As the cope, Fig. 4 must be lowered carefully to avoid any damage to the cores or molds, comparatively long guide-pins 1½ inches diameter are provided. After setting the cope in place, the two parts of the flask are wedged by straps which are pushed over the lugs *L*, Figs. 2, 3 and 4, and finally the joints are smeared with loam.

The cores consist of one-third coarse sea sand, one-third ordinary

molding sand and one-third old sand to which a liquid core binder is added. During drying, which is done at 250 degrees Cent., attention must be paid to the correct time. About three hours is required and if this period is exceeded the cores become brittle and do not offer sufficient resistance to the liquid metal. The molds are dusted with a mixture of powdered soapstone and plumbago that is distributed over the whole surface by a camel's hair brush. The molds are not dried before the casting is poured.

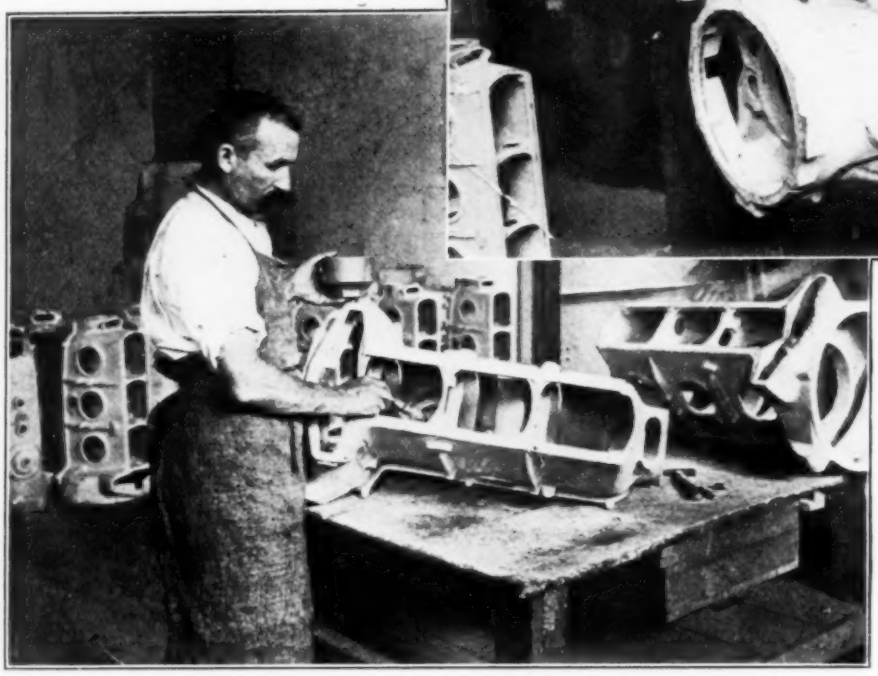


FIG. 10—GASOLINE WHEN APPLIED TO THE CASTING WITH A BRUSH LEAKS THROUGH POROUS SPOTS INDICATING DEFECTIVE CASTINGS

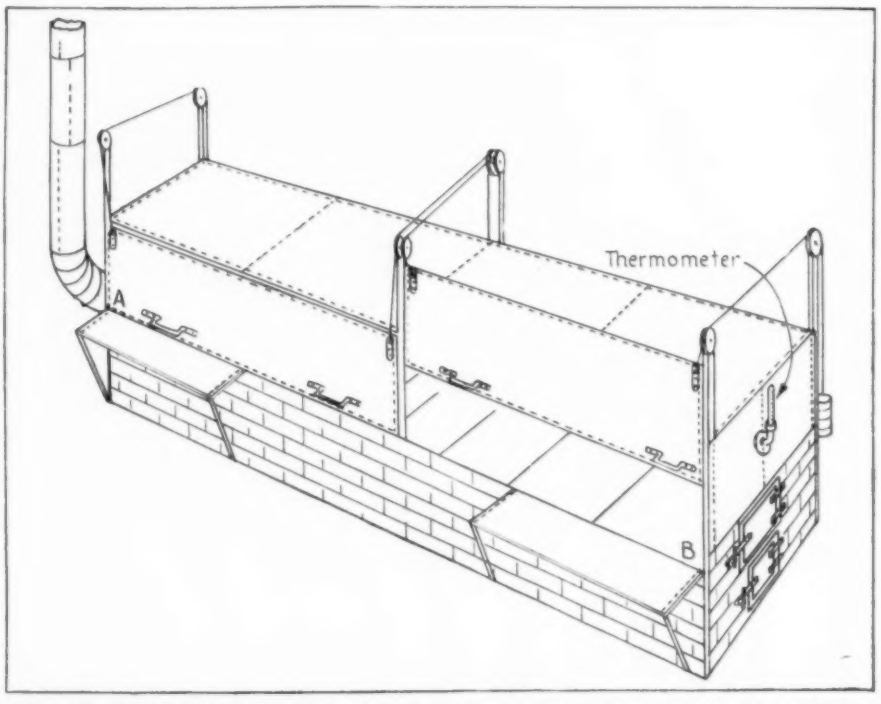


FIG. 11—FURNACE USED FOR REHEATING DEFECTIVE CRANKCASES BEFORE SOLDERING

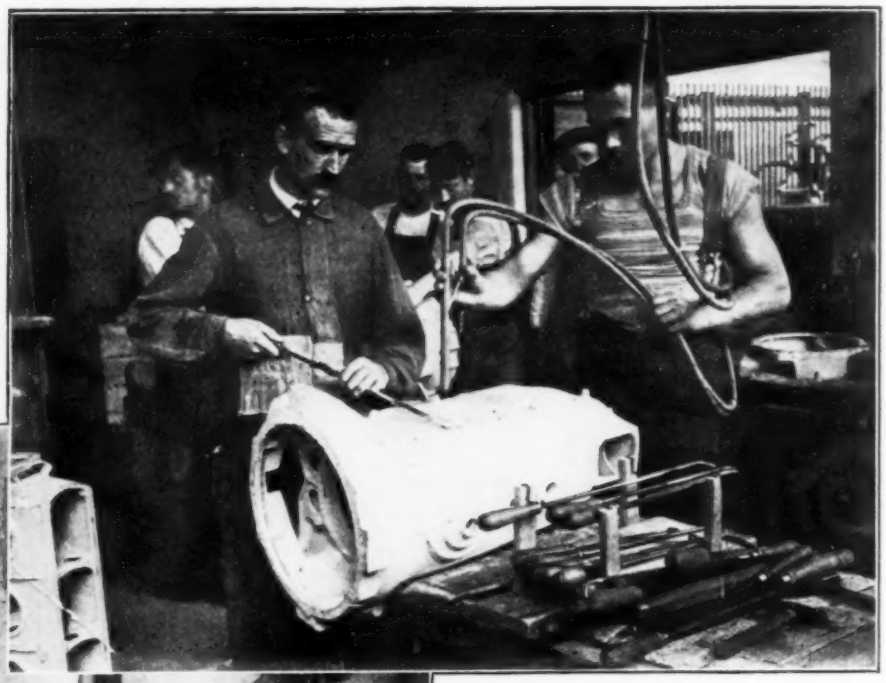


FIG. 12—SOLDERING A DEFECTIVE CRANKCASE

The casting is poured from two sides by ladles supported in ring carriers, each of which is operated by two men. The metal is quietly cast with equal streams through each runner and attention must be paid to keeping the inlets always filled.

An alloy of 91 per cent aluminum, 7.5 per cent copper and 1.5 per cent zinc is used. As soon as the aluminum, which is melted in an oil-fired open-flame furnace, begins to become liquid the required quantity of copper required is added in form of an alloy of 50 per cent copper and 50 per cent aluminum. The zinc is added in the ladle in small pieces which are well stirred into the charge under a cover of sal ammonia or zinc chloride and common salt. In this way the metal is cleaned thoroughly as all impurities rise to the surface in form of slag and scum and are skimmed off. In repeated skimmings the best moment for casting may be determined by observation. As long as the aluminum glows red it is too hot; only when it becomes a rather gray metallic color is it ready for casting.

After being removed from the sand, aluminum crankcases are usually cleaned, in central Europe, by a combination of hand and machine methods. They are first rapped with hammers to remove the loose sand, and then sand blasted. A sand-blast cabinet is usually employed for the latter operation. With a crankcase such as the one shown in Fig. 12 from 20 to 25 minutes is required so that on an average 22 to 24 pieces

are cleaned in an 8-hour shift. As this would not be using the sand-blast apparatus efficiently it usually is operated by three gangs of men working through the 24 hours continuously so that a total output of 70 pieces a day is attained. Each sand-blast gang consists of two men, one of whom operates the machine while the other brings up and takes away the castings.

After being sandblasted the castings are examined for soundness. They are put on a work table and treated on the inside with gasoline, which is brushed on the casting where this is possible. If the casting is in any way permeable the gasoline penetrates to the outside and causes a stain which easily can be discerned on account of its dark color. The inspector marks the affected spot with colored crayon. The speed with which this part of the work is done depends on the quality of the castings. If the castings are good one man can inspect 10 crankcases in an hour, but if they are bad he sometimes finishes only two or three pieces in the same length of time. The inspection is thorough. In general about 30 pieces are handled per man and shift.

Repairing Defective Castings

As a preliminary to soldering small spongy spots are caulked with a center punch. In the case of larger defects the hard skin is removed by means of a chisel and the metal then scoured with a rasping file and scraper.

This preparatory work being done, the whole casting, which might crack if heated only at certain spots, is brought up to a uniform temperature of 250 degrees Cent. in a furnace similar to that shown in Figs. 11 and 14. The firebox and the lower parts of the furnace are lined with firebrick. The base plate is cast iron and the heating chamber is of sheet metal lined with asbestos. On the charging side are two sliding doors which occupy the whole face of the furnace. The castings to be treated are introduced into the reheating chamber at the opposite end from the firebox, at *A*, Fig. 11, from which they are pushed forward gradually to *B*, over the fire, being finally taken out of the furnace when they have reached a uniform temperature of approximately 250 degrees Cent. It is necessary to do the soldering as soon as possible after taking the castings out of the furnace.

For automobile crankcases of normal size the furnace is 16 feet 6 inches long, 3 feet 2 inches wide and 5 feet 8 inches high, the height of the work chamber being 2 feet 5 inches. The great length is necessary in order to bring the castings gradually but surely up to the required temperature, rapid or uneven heating being fatal.

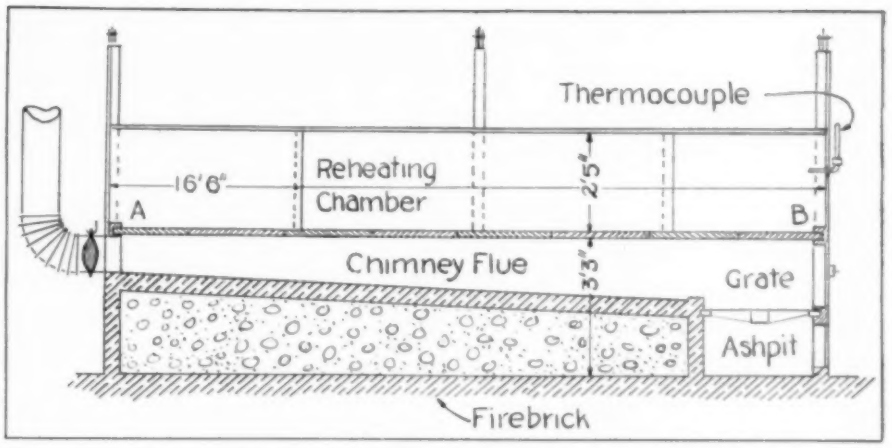


FIG. 14—DETAILS OF THE FURNACE SHOWN IN FIG. 11

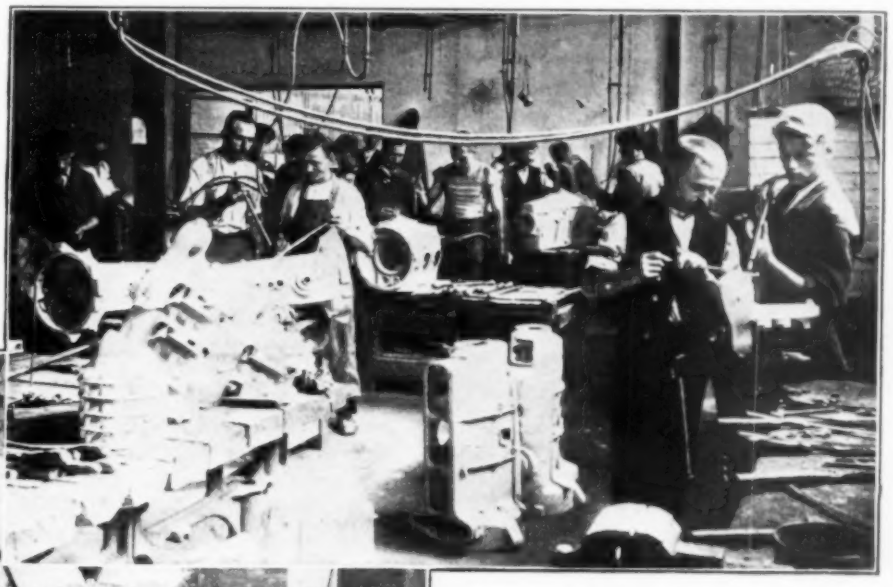


FIG. 15—SECTION OF THE SOLDERING DEPARTMENT

FIG. 13—SECTION OF THE CLEANING ROOM SHOWING CASTINGS READY TO BE SENT TO THE MACHINE SHOP

How Soldering Is Done

The solder used for this work is an alloy of 75 per cent tin, 16 per cent zinc, 4.5 per cent lead and 4.5 per cent aluminum. No flux is used. A water-gas bunsen-type burner serves as a soldering torch. The

operation is illustrated in Fig. 12—the solder being rubbed with a slightly crooked file point until it binds well. Burners which produce a higher temperature were tried and found unsatisfactory. The flame fused the wall of the crankcases before the solder had amalgamated with the main body of metal. Fig. 15 shows a general view of the soldering room.

After being repaired the soldered spots are carefully filed. Then the whole casting is again sandblasted and finally has to undergo another inspection with gasoline. If this test is passed satisfactorily, the casting is passed to the machine shop. Fig. 13 shows a number of castings which have been repaired and sandblasted the second time.

Originally the castings were examined only by eye as carefully as possible. A great many defects were overlooked and in an effort to attain better results testing under hydraulic pressure was tried. It was found that the hydraulic tests were less reliable than inspection by means of gasoline. At first the gasoline was not used economically, about an eighth of a gallon being poured into each crankcase to produce a certain pressure of liquid. It was discovered later that such a pressure was unnecessary as the gasoline was sucked up into the faulty parts of the casting by capillary attraction, making itself visible on the outside in the form of the dark stains already mentioned. At present the gasoline is applied mainly with a brush as shown in Fig. 10. A small quantity is poured into cavities which are inaccessible to a brush. A quarter to a third of a gallon is now sufficient to examine 40 crankcases.

Describes Equipment

An exceptionally complete catalog on material handling equipment recently has been issued by the Yale & Towne Mfg. Co., Stamford, Conn. The catalog is presented as a reference book for use by the engineer, plant superintendent, architect and purchasing agent as well as the salesman. The publication contains complete details of chain blocks, trolleys and electric chain hoists manufactured by this company and shows tables of dimensions, weights, clearances, and lifting, lowering and running speeds. It also covers the essential information regarding each of the previously mentioned articles of equipment for handling materials. One of the features of the catalog is an article by Henry R. Towne, for years president of the Yale & Towne Mfg. Co. and at present chairman of the board of directors. This discussion covers the comparative efficiency of different types of chain hoists.

To Hold International Trades Show

The International Foundry Trades exhibition will be held in Bingley hall, Birmingham, England, June 19 to 28. The first show of this kind was held in 1922 under the auspices of the Institute of British Foundrymen and the Cast Iron Research association, the business management of the exhibition being in charge of the Birmingham chamber of commerce. The exhibition held in 1922 was a decided success, machines and equipment from a number of countries being shown. Approximately 30,000 people attended this show.

The exhibits this year will be divided into a number of classifications as follows: General foundry plant with cupolas, electric furnaces, annealing ovens, core ovens machines, etc.; foundry requisites consisting of facings, shovels, core oil, binders, etc.; pattern making machines of all kinds; molding sands; laboratory equipment; refractories; die casting plant; combined exhibits by British trade groups including gray iron, malleable, semisteel, cast iron, nonferrous and steel castings; raw materials and fuel; material handling equipment; finished material; a complete foundry; technical education; technical lectures; foundry office and works organization; historical; publicity and propaganda.

Secure Engineers

G. M. Haardt, director general of the Andre Citroen Motor Works, France, and a number of associate engineers recently had a series of conferences in Detroit. As a result of these meetings the Jas. F. Miller & Hurst Corp., General Motors building, Detroit, has been retained as consulting engineers. The firm will advise the French automobile manufacturer on building and equipping a large foundry to be built in the suburbs of Paris. The Jas. F. Miller & Hurst Corp. is credited with designing the buildings and equipment of the River Rouge foundries of the Ford Motor Co. Detroit.

The H. & R. Foundry Co., Cincinnati, has been organized with $25,000 capital and has taken over the plant of the Phoenix Foundry Co. of that city, which discontinued business several years ago. The new company will manufacture brass, bronze and aluminum castings. Arthur Remers is president and Harry Hinken secretary and treasurer. Both formerly were connected with the Ohio Pattern Works, Cincinnati.

Honeycombed Lathe Bed Due to Cores

Question: Recently we poured a lathe bed 10 feet long and weighing about 1200 pounds. It was gated along the top joint on both sides and showed no indication of blowing when it was poured with very hot metal. The center of the casting for about 5 feet was clean and solid, but the remainder of the casting at each end was completely honeycombed with gas holes. This is the first of an order of eight castings and we shall appreciate your opinion on the subject before going ahead with the order.

Answer: The honeycombed condition of the lathe bed ends may be due to one or a combination of several causes, but from the evidence submitted we are inclined to the opinion that your cores are responsible. They may not be properly dried, they may not be properly vented or they may be too hard. If any of the foregoing conditions obtain the iron will flutter away from the surface due to gas which finds it easier to escape through the molten iron than through a hard, dense core. The walls of a lathe bed are relatively thin and the result is that the iron sets while it is still impregnated with gas bubbles. The reason the center section of the casting is solid is because a constant stream of hot iron was supplied at that point and kept the metal in the wall in a liquid condition until the bubbling ceased and all the gas had a chance to escape.

You easily can determine the point to your own satisfaction. Take one of the cores and lower it into a suitable hole in the floor. Place several pieces of ¾-inch boards up against one side then ram the hole ful of sand. Remove the boards and slowly fill the cavity with iron. You can note the action of the iron as it rises and determine whether the fluttering is caused by the dry sand core or the green sand wall of the mold. The remedy naturally is to provide a mold and core through which the gas can escape. Decrease the amount of binder in your core sand, fill the interior of the cores with coke so that the core sand merely forms a shell, provide generous outlets for the gas through the core prints, dry the cores until they are on the verge of burning and you will not have further trouble.

It is barely possible that hard, damp, green sand side walls may have caused the blowholes. If that is the case you will have to ram the sand more carefully, work it as dry as possible, use the swab sparingly and run a row of vertical vents about 3 inches back from the wall of the pattern on both sides. Castings of this kind usually are poured through two narrow draw gates at the bottom of each end.

Apply Patented Casting Metal

Its Use for Many Automobile Parts Developed in France—Claimed To Have Properties Superior to the Usual Foundry Aluminum Alloys —Discusses Tests Made of the Alloy

BY R. DE FLEURY

BEFORE going deeply into the subject, I wish to review briefly what alpax is and what its principal properties are. The fact that the inventor, Mr. Pacz, is of American nationality, and the fact that the first experiments were performed in America, will relieve me of entering into some of the metallurgical details, certainly known to the American public. However, the practical applications have been carried on in France for a year and a half with such method and such co-ordination that the telling of these facts will be particularly instructive.

These facts have morever been the subject of a quite recent contribution to the Association of Aerial Navigation on the seventh of last February at Paris, of which we can do no more than reproduce a detailed summary.

It is purely a question of an alloy of 13 per cent of silicon, eutectic point of the series of binary alloys of silicon. It is the special treatments in a crucible with aid of alkaline salts and at precise and well defined and the total absence of iron in the raw material used which gives it its final qualities. These treatments are exactly what the patent of Dr. Pacz cover.

Properties of Alpax

The new metal has the following characteristics.

It shows a density of 2.6 to 10 per cent lower than that of the usual alloys of aluminum for casting. Its density is a third that of steel.

Its resistance to atmospheric agents is at least equal to that of pure aluminum, that is superior to normal alloys of aluminum in the foundry.

It possesses a perfect water tightness, favorable to its use for cylinders for gasoline engines, cooled by water circulation.

Its contraction, which does not exceed that of cast iron, is much less than that of ordinary aluminum alloys.

It is not fragile during the period of solidification. This quality joined to the preceding one, permits us to forsee the production of the most voluminous and complicated pieces without appreciable waste or loss and without risk of cracks; that is, with complete safety in manufacture.

The characteristics of guaranteed thrust are: R is greater than 19 kilograms per square centimeter with A per cent greater than 5, with the supplementary condition R plus A greater than 25. These are mechanical results formerly absolutely unknown, which create a veritable revolution in the use of light metals in the foundry.

The breaking point or load of alpax at high temperatures (300 degrees Cent.) is superior to that of other aluminum alloys for foundry use, a point which increases the coefficient of safety.

In addition, the attention must be drawn to the use of alpax for friction pieces.

Field of Application

The special properties of alpax and its net cost being higher than that of foundry alminum will make us foresee that this alloy will not be substituted for the foundry alloys for present uses, but that on the contrary, it will extend the field of the applications of aluminum into new uses.

To sum up our thought in a manner a little striking, one might say that alpax is to ordinary foundry alloys exactly what cast steel is to cast iron. That is to say, that the metallurgy of aluminum is happily and admirably completed to the same degree as was that of iron, when it was possible to handle the production of pieces of cast steel, a thing still quite recent.

This simple comparison puts a finger on the field of application open to alpax. The following are the automobile parts which may be considered for production on a large scale using alpax: The axle differential castings; the wheels; the brakes; the motor blocs including the cylinders and combustion chamber; the pistons and connecting rods; and the material for body building.

When it comes to aviation there is, on one hand, the lightening of motors by means of the use of an aluminum alloy of less density and more strength. There is equally the possibility of forming in a simple manner the cylinder blocs themselves out of aluminum and without the complications of fusion welding or cutting out of plate iron.

Everyone knows the difficulty and the setbacks and waste resulting from the molding of cylinder blocs in ordinary aluminum because of the cracks or the lack of water-tight qualities, totally overcome by alpax.

In the order of these applications some can be considered as immediate, from the fact that they do not necessitate study or fundamental modifications. This is particularly the case in the application to cylinder blocs. The same models as those for cast iron can be used almost without exception. Other applications necessitate special adaptations and more delicate transportations of materials; these are the differential casings.

Here it is fitting to call the attention once more to a point, that the pieces made of alpax substituted for steel, as is the case in all the light metals, must be proportioned differently.

The search for lightness leads the builder, in spite of himself and contrary to what he should do, to keep on lightening, not only by the nature of the metal, but still more by forms more undercut or hollow, which correspond badly to the modulus of elasticity of the material. The basis of calculations and designs or outlines must take into account not only the density of the metal and its resistance, but also and especially, its modulus of elecasticity.

The rule is that the pieces of aluminum must be designed more massive and of greater extent than pieces of steel. This is not often well followed and it is there that we must look for the main causes of failure in the past in the use of aluminum. If one is on guard against the preceding mistakes or even against the one of making in light metal measure for measure a similar piece designed for steel, in short, if one studies the piece specially, there is rationally no need to fear failure.

Casting the Alloy

The founding of alpax then admits of the production of heavy pieces of an extensive degree of development, stiffened by ribs and cores of which the rational design or outline will have to necessitate a close co-operation of the producer, foundrymen and mechanic, till the time when the necessary enthusiastic interest in the use of a new product will have become standard in its turn in the laboratories of research

I will not bring up here the theoretic consideration of the resistance of materials and that which follows is only an experimental illustration, in a way.

In October, 1921, charged with an investigation on silumin, at the Berlin automobile show, that is to say, on alpax, I saw differential casings and wheels of

Annual exchange paper of the Association Technique de Fonderie of France, translated from the French, and submitted at the convention of the American Foundrymen's association, held in Cleveland.

automobiles, and especially of trucks, cast from patterns designed for steel and normally in use with that metal. We have already said that the simple substitution of alpax for steel was a mistake. I do not know how the experiments came out, but from that time on, I have been taking all precautions in the matter of dimensioning which seemed to me normally would have to end in almost certain failure.

The fact is that the Germans seem to have eventually limited their effective effort to the substitution of alpax for bronze in railway bearings. However, it is fitting to lay stress on the fact that they have arrived at an important generalization of which the initial purpose was especially a question of avoiding an importation of copper. A hundred tons of alpax are used monthly in the manufacture of this product.

These bearings were, moreover, antifriction of an alloy of lead and barium called Lourgi metal eliminating equally the importation of tin. However, this is only said incidentally, because of the economic interest of the fact that we shall have to do the same in France.

Since then the occasion has been offered me of looking at the question from a point of view much more general and rational in applications which concerns the automobile industry, taken as an experimental field. I have been able to benefit largely from the closely co-ordinated co-operation of the Alais company, producer of the metal, the Craus Foundry, working the metal, and especially Mathis, the T. C. R. P. and Panhard as builders, which explains sufficiently the fundamental causes of the successes observed. I must, therefore, above all thank these powerful and progressive promotors.

Makes Interesting Observations

Cylinder blocs have been produced without modification on the cast iron patterns by the Craus Foundry.

The first example was a cylinder bloc of the Mathis runabout where some interesting things were observed.

As a result of a mistake of model, a sample piece, not intended to be used, was sent to the builder, simply as a verification of the figures of a defective model. The interior cylinder, bearing many little flaws, had at first been rejected, then following a trial to find a favorable water tightness, it had, nevertheless, been put into service without interior lining, with pistons cast for friction directly on alpax and without separate valve seats. This motor has been functioning perfectly for 4 months, which makes the high imperviousness of the metal and its good lasting qualities stand out. This piece, which only weighs 7 kilograms, (15.4 pounds) shows a saving of 12 kilograms (26.4 pounds) in comparison with the cylinder bloc of ordinary cast iron, which weighs 19 kilograms (41.8 pounds).

The second example was that of a Panhard valveless motor, without interior lining. This motor has also been functioning for several months.

Other cylinder blocs are equally in use for motorcycle engines, also shortly it will be tried on aviation motors with an appreciable gain in lightness of weight, even on cylinder blocs made of welded sheet steel, with a considerable economy of production.

The considerable simplification and lightening which results from the possibility of cylinder blocs of alpax; of completely doing without not only separate seats for the valves, but even the lining of cast iron, presents an interesting problem concerning the resistance to friction of aluminum pistons in these motors.

The friction of cast iron on aluminum is already determined in the ordinary motors with cast-iron cylinders equipped with aluminum pistons. It is this knowledge which led us, at the time of the Mathis trials already mentioned, to adopt on trial cast pistons on alpax cylinders.

Diminution In Quality

But these motors being designed to revolve rapidly with masses in alternate motion, there follows a certain diminution in the quality of the motor. The trials which bear on the utilization of alpax cylinders with aluminum or alpax pistons are of a primary interest. Results cannot be definitely determined until after the trials now going on, have lasted sufficient time to constitute the sanction of usage. It is probable that the judicious choice of alloys a little different for the cylinder and the pistons will allow the uncertainty to be solved in a favorable way. At the present time a motor is being equipped with a view of trying out cylinders of alpax, and magnesium pistons of the Association of Electro-Chemistry. The latter company is, moreover, on the point of placing on the market this kind of piston in standard types. We shall then have something to say about them again.

The question of differential casings is particularly interesting even for aviation, because it constitutes an effective and practical test of alpax in parts undergoing important stress. It has necessitated a workmanship more careful than that of cylinder blocs. Four types of casing have been placed under test with success or are in process of experimentation.

A Mathis differential casing, single piece as far as the brake boxes, including and containing all the housing for ball bearings without either interior or exterior armature, has been cast by the Craus Foundry. This casing was largely dimensioned the same as the old casing which was constituted of malleable cast shells, bound together by tubes of steel.

Increase Diameter Relations

On an average, in the working parts, where there is an equal thickness of the walls of the tubes, the relation of the diameters was increased in the ratio of 1 to 1.7. Such a margin of dimensioning permits of replying victoriously to the objections of theorists on the relative fragility of light metals. These castings mounted on racing cars have, twice, lasted well on machines much heavier and more powerful than the ones for which they were designed, at a time when the casings of ordinary construction had given way in tests. Now these casings in question weigh about 10 kilograms (22 pounds) less than the casings of customary manufacture, which constitutes a considerable gain, if one remembers that a Mathis cyclecar has a total weight of about 350 kilograms (770 pounds). The casing in question weighs 7 kilograms (15.4 pounds) in the rough and has undergone a bending test under a weight of 1000 kilograms (2200 pounds) at the center, the supports being thus at right angles with the springs. It has been functioning for several months in several test cases without incident.

Let us note in passing that the simple substitution of the bloc cylinder and of the differential casing on the vehicle of less than 350 kilograms with some accessory pieces, such as coupling clasps and wheel spindles, reduces at once, the weight 30 to 40 kilograms (66 to 88 pounds) that is to say, more than 10 per cent of the weight of a vehicle which must not go beyond 350 kilograms.

The second systematic test was effected on a 2-ton Panhard A R casing, also cast by the Craus Foundry. The necessity of retaining certain small parts in the axle journal so as not to revolutionize completely the construction of the machine which would have led to costly tests, led to the retaining of an axle journal of the steel already on hand. The latter was put into the mold and the alpax cast around it. Of course, this axle journal was pierced with holes permitting the very careful attaching of the metal independently of the considerable tightening assured by the contraction. Also the exterior diameters of the ends of the casings were considerably increased, but they were similar in thickness to the initial casing in cast steel.

The gain in lightness of construction was, of course, considerable. Flanged axle

journals existed in the former steel casings in such a manner that the saving in weight went as high as 50 per cent. This differential casing has been in intensive service on a Panhard light truck for several months, and is giving complete satisfaction to the builder.

A complete rear system bearing the differential casing and wheels, has been produced with the help of Mr. Mariage and of Mr. Vergniole for the T. C. R. P., also cast by the Craus Foundry. The single piece differential casing bore steel axle journals shaped in a press. For an even pressure, for shaping, the smaller modulus of elasticity of alpax necessitated more important changes in design for expansion for alpax superior to those planned for steel.

It has been possible to settle the problem in a way to avoid any ripping slit at the end of the cone of the alpax differential casing by forcing the tightening to the end of the cone and less at the base. This differential casing was designed, as the preceding ones, with a strong increase in diameter, while retaining the thickness of cast steel, with the exception of the Mathis differential casing where the thickness had been reduced to 4 millimeters (0.15 inches).

Finally, another design, also one piece, bears in each end a steel tube of small diameter set in for the sake of safety for the machines weighing from 700 kilograms (1540 pounds) to 2 metric tons (4410 pounds). The outward appearance of it is strictly similar to the one of the little Mathis casings. It is likewise, the Mathis which is undertaking this reinforced solution for a machine of greater strength.

This form has moreover been much noticed for its elegance and simplicity of line by the foreign correspondents at the time of the last automobile show, and other builders are in process of adopting it. This solution has a good chance of being worth more than the casings stamped out of thin sheet metal which are adversely criticized both for the high net cost and their lack of rigidity.

Independent of the axle journals of the above types, or those shaped on a press, there exist other differential casings where the axle journals are simply assembled by bolts to the ends of mud shield of the alpax differential casings.

Observation having shown that the refining of alpax is less perfect in large sections than in small ones, I was led to build up the wheel with the use of three thin sheets instead of twice as many thicker ones, that is to say, with rather complex cores. These designs are about to be put into circulation. However, the reduction in weight compared to wheels of steel, formerly used, goes as high as 75 kilograms (165 pounds) per wheel of full size and 75 kilograms for the differential casing.

The production of these big pieces, differential casings and wheels, shows the extreme ease of casting the biggest and most complicated pieces in a sensible and safe way out of alpax, at a time when the same result is uncertain with ordinary aluminum because of the flaws and cracks.

The alpax piston has given cause for interesting and constructive observations which make it appear what a change of material, small in appearance, if one compares it to the aluminum pistons, can necessitate in the way of modifications and precautions.

Of the types of the designs which I have directly controlled and whose operation I have been able to observe, it is seen in the first place, that the alpax piston can be turned out almost exactly on the same specifications as the cast-iron piston of the same bore.

Few Motor Troubles

The interest of this observation is considerable, because it means the suppression of the *knocking* which has been so much criticized in the ordinary aluminum piston, to which there has sometimes been given excessive play. A T. C. R. P. test motor ran on the bloc in an almost entirely satisfactory manner, with a few almost insignificant motor troubles, with alpax pistons adjusted exactly on the specifications of the cast-iron piston. The bore was 10.5 centimeters (4.13 inches).

The final motor, which was put into use on a regular autobus, followed specificatiaons for a piston much more like those of cast iron than it would have been necessary to use with ordinary aluminum. Likewise, the Mathis firm has told me that one of its motors has run in a satisfactory way with alpax pistons machined to the same specifications of revolution as cast iron pistons. However, a slight lessening of power being noticed under these conditions made it evident, for these high speed motors, that these figures were the origin of a certain tightening, that is to say, like the action of a brake. In short, this indicates that it is necessary to keep to specifications of revolutions for alpax almost the same as for cast iron, without attaining, and far from, the play needed for aluminum.

Of alpax pistons made on current models of aluminum and submitted for my examination only as a result of something happening to their functioning, there resulted observations concurred in by the three following builders: Chenard, Sizaire Berwick and Panhard. In short it seems indispensable to give to alpax pistons a thickness in matter of depth of 20 per cent more than that of pistons of aluminum alloy of 12 per cent copper.

This solution is entirely effectual and besides does not constitute in any way an inconvenience; the thermal conductivity is in reality increased from this fact, which is a marked advantage; and the piston is not heavy compared to the old aluminum piston, because of the smaller density of alpax.

An aluminum connecting rod, whether it be stamped in alloy of aluminum of the duralumin type already in most universal use in America, or whether it be of cast aluminum, necessitates large sections of high momentum of inertia, by reason of the slight modulus of elasticity upon which alone depends its resistance to axial compression. It is conceived under these conditions, that cast light metals of relatively slight resistance, being well proportioned in sections might suffice in a satisfactory manner in the production of connecting rods, at least for preliminary tests of functioning and endurance, on a certain scale, avoiding the large expense of a metal die. A simple, cheap, wooden pattern suffices.

One autobus at least is running at Paris equipped with cast alpax connecting rods, fastened to the alpax pistons already mentioned, among the pieces on test of the T. C. R. P. It is now 4 or 5 months that the first motor thus equipped has been running in a satisfactory manner. Several other motors are going to be put into service. The connecting rod has for the crankshaft the ordinary antifriction bronze bearings of motors.

The respective weights of the moving parts of cast iron and steel on one hand and of alpax on the other are as follows:

	Steel and cast iron parts	Alpax parts
	—Kilograms—	
Connecting rod	1.370	0.985
Piston and parts	2.105	0.910
Total weight	3.475	1.805

These figures show a reduction in weight of 1.670 kilograms (3.68 pounds), or 48 per cent of the initial equipment.

The experiments enumerated or undertaken, the difficulties solved or pointed out, will enable us to avoid, by care and consideration, much future experimentation.

In a machine or an apparatus which one wishes to lighten to the extreme point, there is not a shadow of doubt that the use of light metals in massive pieces gives greater possibilities than those of high resistance steel in thin pieces.

But this rule leads to certain consequences and certain possibilities on which it is well to have clear ideas. The fact is that working in light metal requires

an interpretation in large volumes and in big sections.

As mechanical construction ends in the long run in having to put more attention on the points of bearing or of application, it follows that there is always a certain difficulty in the use of light metals, in establishing the connections suitably extended and distributed between the pieces made of light metals and those of steel. Where to start or indeed where to end one's efforts in concentrating on it is a problem. It is a simple difficulty of construction.

But in this process, the most minor questions become the source of unforeseen difficulties accumulating before the experimenter. The one of cleaning plugs, for example, in cylinder blocs in alpax, has been the origin of leakage of water, because of the fact that the losses designed for the threads of the aforesaid stoppers were sufficient, because of the small lasting qualities of the metal with reference to cast iron. It was necessary to make the piece over with reinforced losses. The smallest bolt does its part to hinder the experimentor.

Alpax is subject to exactly the same requirements of use as all the light metals and necessitates the same patient testing and the same experiments.

Men, impatient or uninformed, have on meeting setbacks, a tendency to blame, not their relative inexperience, but, on the contrary, to blame the material. It is thus that we see the best solutions often rejected at the start; then taken up again some 10 years or more later causing a great loss of time.

The present article will show that in France at least, designs, using alpax, methodical and at the same time daring, are not only in course of test but in universal use. The French automobile industry, always in process of evolution, is probably tending in a short time toward types of vehicles both lighter and stronger than the present types, consequently more economical and consuming much less material, thanks to the use of light metals. Alpax of American origin, has found there a welcome of the most favorable order by the big makers of automobiles and by foundries specializing in the light metals.

How and Why in Brass Founding

By Charles Vickers

Making Phosphor Tin

We would like to know how phosphor copper and phosphor tin are made as we are located in a part of the world where these supplies are unprocurable. How is the phosphorus bought? Also how is it mixed with the tin or copper. We also would like to know how hard brass can be softened. At present we add copper and then lead to improve the machining qualities. We make both iron and brass castings, our line being mainly repairs for sugar mills.

The most common form in which phosphorus occurs in commerce is in the shape of sticks that resemble wax candles, about ¾-inch in diameter. It is packed in 1-pound cans, also in larger cans. It has to be kept under water at all times, and should be stored in some vessel that cannot spring a-leak. This is known as yellow phosphorus, and it can be used in this state to make phosphor bronze, or as a deoxidizer. For the latter a piece about 2 inches long tossed onto the charcoal-covered surface of the metal is sufficient. It can be stirred in immediately. Phosphor tin can be made by *feathering* the tin, that is by pouring it, when just melted, into water, using great care with the work. Balance a can half full of water on the scale and pour the phosphorus into it figuring about 6½ pounds of phosphorus to 93½ pounds of tin, some of which can be ingot. Pack the tin and phosphorus in layers in a large crucible, cover with bone ash and gently heat, liquifying the tin. Make an analysis of the product for phosphorus, and additions can be made to metals to add a definite amount of phosphorus. Hard brass only can be softened in the manner now used, by the addition of copper, and also of lead.

Manganese Bronze

We require a mixture of approximately 53 to 62 per cent copper; 36 to 54 per cent of zinc; 0.05 per cent aluminum, and not over 0.15 per cent lead, the tensile strength must be 70,000 pounds per square inch, elongation 20 per cent in 2 inches. We believe that about 2 per cent of manganese should be added to this mixture to bring the tensile strength up to specifications. Can you advise us in regard to a proper mixture?

The alloy is a manganese bronze, but the aluminum is too low to get good casting qualities combined with the tensile strength and elongation specified. It should be increased to a minimum of 0.5 per cent. The lead will do no harm even when used in greater proportion than specified, but this requirement can be met by using an electrolytic zinc. Addition of 2 per cent manganese will not bring the strength up to the specifications. Some such formula as the following will meet the specifications.

MANGANESE BRONZE

	Per cent
Copper	55.00
Zinc	42.38
Iron	1.25
Tin	0.75
Aluminum	0.50
Manganese	0.12

Improve Brass Castings

We are making brass castings known as oxidizers which are simply hollow cylinders, flanged at both ends with a small, curved branch pipe extending from one side and connecting to the main body about one-fourth the distance comprised in the body between the flanges. This branch curves in the direction of the nearest end and carries a flange also. The castings weigh around 35 pounds each, and are molded from a split pattern, half in the drag and half in the cope and in casting them we get all the dirt in the bottom, the top and other parts being clean. We use an alloy consisting of copper 90 pounds; zinc 4 pounds, and lead 2 pounds, which stands the heat very well. We ask if you can suggest any method to avoid these blow holes. We use linseed oil and lake sand for cores, and melt in a furnace operated by air and natural gas.

We are unable to decide from the question and the sketch exactly how the molds are poured; whether horizontally, or vertically, the mold being upended. In the latter case and with a gate extending the length of the casting and curving into the lower end it would be quite a conundrum to figure out how it is possible for the lower end of the castings to become dirtier, or more porous than the top end or the middle.

Poured horizontally, the defects in the drag half may be caused by using too shallow a drag half. This would increase the difficulty of carrying away the gases from the face of the mold, as there would not be sufficient sand

underneath the casting. This is a matter to look into. Also note if the sand in the drag is being rammed harder than necessary. Have the cores thoroughly vented and well burnt to get the gases away from the core surface quickly and have them pass through the body of the core as they should. Have a larger vent opening than usual, and take precautions to prevent the metal gaining egress thereto. Do not allow the molds to be filled up with hot sand at any time.

The alloy would be improved by the addition of tin, as it stands now it consists of copper, 93.75 per cent; zinc, 4.166 per cent, lead, 2.033 per cent approximately. It would be greatly improved by making it copper 92 per cent, zinc 4 per cent, lead 2 per cent and tin 2 per cent. Use bottle glass on the surface while it is melting, as charcoal would be blown away. Place about two ounces of phosphor copper in the bottom of the pots when commencing to melt. If these instructions are followed the castings should come sound.

Adding Chemicals to Yellow Brass

We propound the following questions to which we would like answers: (1) *What effect does the addition of too much phosphorus, used as phosphor tin or phosphor copper, have on castings made of all scrap yellow brass?* (2) *Is yellow prussiate of potash good for remedying porosity in yellow brass? If so, how is it used, stirred in or put in bottom of crucible?* (3) *If yellow prussiate of potash is so used, should it be added alone or in conjunction with phosphorus?* (4) *In remelting porous castings what precautions should be taken, what percentage of phosphor tin or copper should be added?* (5) *In a casting with a section of approximately 3 x 7 inches, should the metal be poured hot, or fairly cool? We test the temperature by inserting a cold iron rod, and if the metal fails to stick we conclude it is hot, and we then cool a little before pouring.*

(1) The addition of a considerable amount of phosphorus to yellow brass, whether scrap or new metal, increases the fluidity of the alloy to such an extent that it will penetrate the sand something like water, if not poured at as low a temperature as it is possible to fill the molds. It also hardens the alloy and 35 or so years ago such hardened yellow scrap was frequently used for bushings and bearings. It is used less extensively now as leaded alloys are considered better. Outside of this the phosphorus works no harm. It does not cause porosity, but such treated metal will produce porous castings just as easily as an untreated alloy, and especially as a result of molding defects.

(2) Yes; yellow prussiate of potash, or ferrocyanide of potassium as it is also called, is a deoxidizer of copper alloys, and is particularly suitable for bell metal. It adds iron to the metal. It should be wrapped up in paper, the package should be dropped on the metal surface gently so it rests on the charcoal, then the furnace should be closed until the water of crystallization has boiled out of the prussiate of potash, then it is stirred in. If stirred before the water is boiled away, there will be an explosion.

(3) No; yellow prussiate of potash and phosphorus should not be used together; no particular harm would result, but it would be a waste of phosphorus.

(4) Melt them under charcoal just like any other metal. If porosity comes from the molds, the second melt of the porous castings poured into properly constructed molds will give sound castings. If the metal is at fault, the second melt castings will also be porous. Therefore, to determine where the fault lays make the second lot of molds in a molding sand two grades coarser than the one first used, and use an open core with no blacking on it. The molds might also be dried. Then, should they produce porous castings from the remelt, it is time to look carefully into the melting methods.

(5) The metal if phosphorized yellow brass will have to be poured as cool, as possible, when it slightly sticks to the stirrer. Massive sections are difficult to get clean in yellow brass. Have large gates and risers and pour as cool and as fast as possible. If the castings are not intended for pressure resisting, add 2 ounces aluminum per hundred pounds of alloy, then rise the metal into the mold and pour when it smokes only when the skin on the surface of the molten metal is disturbed by the skimmer. Small castings of yellow brass containing no aluminum should be poured hot.

Aluminum Alloy Molding

We desire information concerning the method of gating, kind of molding sand required, pouring temperature, removal of porosity, and machining properties of the following alloys: (1) *Aluminum 96 per cent, copper 3 per cent, manganese 1 per cent,* (2) *Aluminum 95.50 per cent, copper 4 per cent, nickel 2 per cent, magnesium 1.5 per cent.*

It is impossible to outline methods of gating castings without drawings, and to make intelligible drawings it is necessary to know all about the shape of the castings to be made. However, gate the molds for these aluminum alloys, exactly the same as for the ordinary No. 12 alloy. Do not be afraid to put on high sprues and heads, remembering that aluminum alloys are only one-third the weight of brass. The pouring temperatures will have to be adjusted in the foundry, and are governed entirely by the shape and weight of the castings. Pour as cool as possible to run the castings. What will be cool for one casting will be hot for another. There will be no porosity unless the alloys are poured too hot. Therefore, it is important to settle the pouring temperatures at once, which can be best accomplished by one or two experiments in pouring at different temperatures as determined by pyrometer. The machining properties of alloy No. 2 will be better than those of alloy No. 1 owing to its content of magnesium, alloy No. 1 is of a more clinging nature than No. 2, and it also is softer. Should it be necessary to improve its machining qualities add magnesium, and deduct from the copper content.

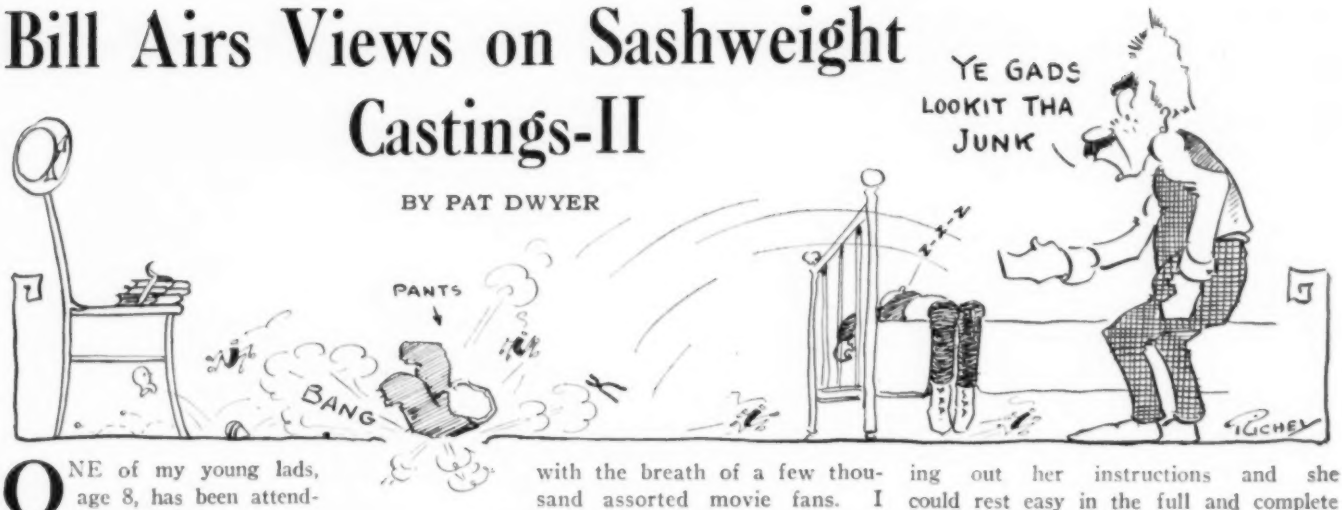
Melting Large Blades

We have 10,000 *pounds of manganese bronze on hand in the shape of four large propeller blades which we wish to put into such shape we can melt it for castings. We have been unable to break it at a red heat by beating with sledge hammers. Can you advise how we can handle this economically?*

The blades can be broken under a ball drop such as used for large masses of scrap iron. It will be necessary to first chip grooves across the blade where the break is desired. This can be done easily with an air hammer. Lay the castings with grooved side down on supports under the ball and drop the latter and the casting will break without difficulty. In this manner the blades can be reduced to sizes that can be handled in the brass furnaces. If the latter are small coke fired crucible furnaces, put the broken pieces of blades in and get them hot enough to be broken. When red hot the heat was insufficient to make the metal tender enough to break. The best way to prepare such material for melting is first to break up the casting as small as possible, possibly each blade can be divided into four or five parts. When in this condition send them to a smelter who operates a reverberatory furnace and have them run into ingots. There are makers of propeller wheels who operate reverberatories that will accommodate a complete wheel of the largest size. In this case wheels are charged by removing the top of the furnace. Thus manganese bronze in the shape of scrap wheels can be bought for a few cents per pound and run directly into new castings.

Bill Airs Views on Sashweight Castings-II

BY PAT DWYER



ONE of my young lads, age 8, has been attending school for the past few years and as nearly as I can judge from the evidence so far presented he is destined to be a great collector.

It is rather early to arrive at a decision and I do not know whether to feel gratified or alarmed at the symptoms. According to the published biography of all our prominent men, the collecting hobby is not taken up until after they have accumulated a sufficient quantity of the mammon of iniquity to render them independently wealthy. In other words, after they become tired collecting money, they turn their attention to collecting other materials that will be equally useless after the old man with the scythe and the sand glass has tapped them on the shoulder and invited them to accompany him on a certain journey. I sincerely trust it will be many a long day before my little fellow attracts the attention of the old gentleman, but in the meantime the fact that he has reversed the usual procedure has led me at times to wonder just how the experiment eventually will terminate. Between the load of school equipment he carries back and forth in his arms and the pile of junk he smuggles around in his pants pockets I am afraid he will sink some day with all hands and become a total wreck.

His mother usually puts him to bed, but one night recently she went out, as she said, to get a breath of fresh air after being confined all day in the house. She is a firm believer in the immense benefit to be derived from this well know invigorator and likes to take her share by attending a movie show. At times I have been moved to question the purity of the air in one of these places. In fact on more than one occasion I have intimated, cautiously, that the air in our own house was cleaner than the air in a place contaminated with the breath of a few thousand assorted movie fans. I regret to say that on each of these occasions my well meant remarks have been received without even the slightest symptom of enthusiasm or support. On the contrary and to my astonishment I have been told that I have no conception of the monotonous grind of a woman's daily life and everlasting round of petty duties. I am not cooped up all day in a cage—Oy, oy, that's a hot one!—I begrudge her a little innocent recreation and finally I am lazy. Otherwise I would go for a walk in the evening and get the benefit of the fresh air and exercise instead of parking there in a chair with my stockinged feet cocked up on another chair, filling the air with the reek from an old, highly respectable and veteran corncob pipe. I always have been surprised when a lady who professes a warm admiration for the ballad *When the Corn is Waving Annie Dear* should turn up her nose at the same corn in another shape.

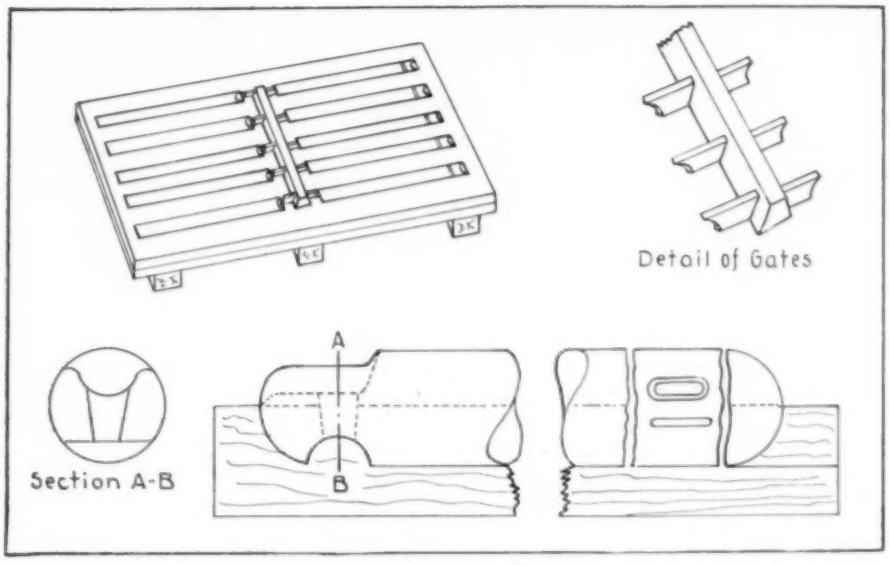
The other night we indulged in the usual light repartee while she was pulling on the gloves—not the boxing kind, thank heaven—and she added a final touch, the usual last word to the effect that she depended on me to pack the young lad away into bed at 8:30. I assured her that I fully appreciated the privilege and pleasure in carrying out her instructions and she could rest easy in the full and complete assurance that at least for one night in his life the young man would retire on the dot. Really, my intentions were of the best, but after she left I picked up a book and forgot all about the solemn obligation.

Remembrance came when one of my other assistants tripped over the little fellow sleeping on the floor and the piercing howl which announced the accident also directed my attention to the fact that it was about time for the return of his mother. Each time I fall down in the performance of some solemn duty to which I have pledged myself in the foregoing manner, I make an earnest vow it never will happen again and—then do as you do.

Then I discovered anew that the way of the transgressor is hard. Instead of tripping lightly upstairs in the wake of a young imp traveling under his own power, I found that I would have to carry him either in the orthodox manner under one arm or over one shoulder. I tried the under arm method first but found that he drooped too far fore and aft. His toes bumped the stairs steps in an annoying manner Then I draped him gracefully over one shoulder and in that position we made the remainder of the journey without any further trouble.

When I set him on his feet on the floor he collapsed. I had to sit on the edge of the bed and grasp him in an upright position between my knees for a few minutes while I was making up my mind on how best to go about the delicate and mysterious job of peeling the clothes off him. I anticipated no particular trouble with the jacket and pants, but when I surveyed the shoes! Sweet mother! Will some person, any person, tell me why the two symmetrical bows into which a little boy's shoe laces are tied each morning, invariably developed be-

SOME PEOPLE ALWAYS ARE ASKING QUESTIONS



(UPPER LEFT)FOLLOW BOARD WITH RUNNER IN PLACE (RIGHT) DETAIL OF RUNNER (LOWER) DETAIL OF PATTERN THE NUMERALS REPRESENTING THE WEIGHT ARE RECESSED

fore night into a tangle that leaves the famous old Gordian knot gasping with envy.

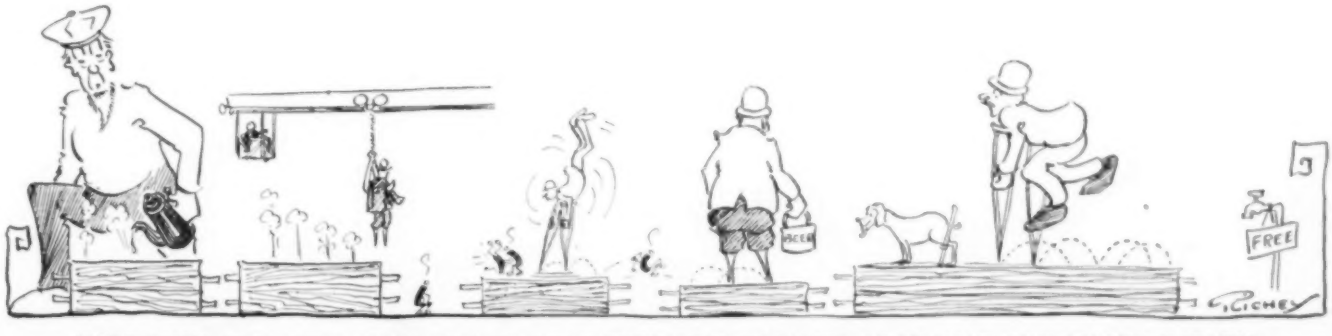
I worked over those knots until the ends of my fingers were numb, but I might just as well have tried to unravel an emergency double bowline hitch in a steel cable. I was handicapped to some extent by the total lack of co-operation on the part of the party of the second part. Finally I decided to roll him into bed shoes and all and dispense with the formality of removing the shoes and stockings. I argued quite logically that since he had slept so peacefully for an hour while his feet were encased in their usual daily covering he would experience no inconvenience for the remainder of the night in the same condition. In fact for the moment I rather congratulated myself upon the happy inspiration which promised instant relief from the predicament in which I found myself. I further reflected that in the morning he would be saved all the time and trouble incident to searching for the shoes and fastening them again on his feet.

I laid him flat on the bed and without any great trouble removed his jacket, but when I attempted to strip the knickers from his little short legs I ran into another snag. The lower extremities of the knickers were drawn in so tightly that I found it impossible to draw them over the shoes. After struggling vainly for some time with the problem I turned the knickers inside out with the vague idea that perhaps I could pull them off after the manner I had practiced in my youth when skinning a rabbit. I discovered a buckle and strap inside each leg and when I had uncoupled these devices I removed the knickers quite readily.

By this time I was just about in proper trim to go into the ring with anything on two feet and since I was denied this blessed privilege and pleasure for want of either a ring or an opponent I decided to ease my outraged feelings by flinging the knickers with great force and violence against the opposite wall. The weight of the garment as I whirled it aloft made me pause and when I lowered it to examine the pockets my resentment vanished in a wave of amazement. How any small human being could smuggle that assortment of junk around all day without becoming hump backed and bandy legged is beyond my comprehension. He had everything in his pockets except the kitchen stove. I found a pair of pliers for which I had searched in vain for several days, a knife, a dozen marbles, three lead soldiers, a 3-inch metal penny marked Niagara Falls, a ball of string, a sling shot, a handful of *BB* cartridges, a small brass door knob and a doll's head minus the hair and one eye, which I recognized as the one time property of his little sister. Only the night before I had heard her bitterly bewailing her loss and now that I was in a position to add two and two together I remembered the saintly and solicitous manner in which the piratical young villain had pretended to help her find it.

The time, the place and the circumstances rolled the years away and brought up visions of my own school days and by a curious association of ideas the knife reminded me of the story of Alexander the Great and his adventure with the famous Gordian knot. The Oracle at Delphi had declared that whoever would loose the knot would be ruler of Asia. Many men tried and failed. Alex came along in his masterful way, heard the story, curled his fine, long Macedonian nose in a contemptuous sniff, favored the Oracle with a gentle and scarcely perceptible droop of his left eyelid, whipped the long sword from his side and sheared the knot from its moorings with one single lightning swing.

Education after all is a wonderful thing. I opened the knife, cut the laces, removed the shoes and with a sigh of relief and the joy of achievement which rewards a man who has performed his duty faithfully and well, I tucked the little junkman under the blankets. I stacked the clothes with studied carelessness on a chair so that the shoes were underneath and only the toes appeared. I was back on my usual perch when his mother returned a few minutes later and in answer to her first question assured her carelessly that I had put her son to bed long ago. I am afraid she lacks confidence, that beautiful love and trust which a lady should entertain for the unworthy creature she at one time promised to love, honor and obey. Before removing her wraps she bounced—well, perhaps I should not say bounced, she is beyond the bouncing age—she proceeded upstairs, switched on the light and satis-



MORE WAYS OF MAKING SASH WEIGHTS THAN EVER WERE DREAMED OF IN YOUR PHILOSOPHY HORATIO

fied herself by a personal examination that the little fellow was anchored properly for the night.

I was away to my daily toil on the following morning before any person became aware of the operation and certainly when I returned at night I carefully avoided reference to any subject that by any conceivable chance might lead the conversation in the direction of either shoes or shoe laces. However, the peculiar sixth sense which all well trained husbands develop sooner or later, warned me that I would hear bad news from a medium blonde lady about 8:30 p. m., so I prudently decided to pay Bill a visit for an hour or two. I found him at home and for a wonder doing nothing. He is a good old scout and I had no hesitation in relating the story which led me to seek sanctuary with him for a short period. "Faith," said Bill. "I am glad to see you any time whether you have an excuse or not. However, the incident of the laces shows that you have glimmerings of common sense occasionally. You should have cut them in the first place instead of wasting all night fiddling over the knots. You remind me of foundrymen who decided to make sashweights and then blindly plug away at a certain method because forsooth they have heard that a competitor in Kalamazoo or Apohaqui uses it. They do not stop to consider that conditions are not the same in all foundries or that special conditions require special methods. The most efficient method to adopt for making sash weight castings depends almost entirely on local conditions so that no man can say positively that there is any best way. A method might serve satisfactorily at one time and place and prove totally unsuitable under other conditions. A short reflection should be sufficient to convince any man on this point, for the same holds true in practically every division of the industrial field. For example immense and elaborate sand handling systems are a necessity and have proved profitable investments in foundries where great quantities of sand are handled daily, but would be neither necessary nor desirable in a general jobbing foundry where most of the patterns are bedded in the floor and where the same pattern rarely is employed more than once or twice.

"For the same reason a costly and elaborate outfit is out of place where sashweights are made only in small or comparatively small quantities. On the other hand, it is apparent that a considerable investment in pattern and flask equipment is justified where large production is anticipated. Between the two extremes a practical knowledge of foundry practice is required to decide on the best method to adopt. Since you are not in any particular hurry I will touch on the various methods with which I am familiar and if you know of any others I shall be glad to add them to the list.

"The most simple form of pattern equipment is a set of full sized patterns in graduated sizes from 3 to 12 pounds weight. Ten patterns of each size usually will be sufficient. They are turned easily in the lathe to a uniform diameter of 2 inches. If old castings are available the proper length may be determined by comparing the pattern wi' the casting. If no castings are on h'' the proper length may be found the cut and try method.

"A tentative pattern is roughed on the lathe and weighed. A pine pattern weighs 1/16 of its counterpart in gray iron. One pound avoirdupois contains 16 ounces and therefore each ounce of casting corresponds to one pound of casting. Thus a 3-ounce pattern will produce a 3-pound casting, a 5-ounce pattern will produced a 5 pound casting and so on for any weight casting desired.

"If a person is mathematically inclined and has the necessary time and patience he can compute the weight on a volume basis. One cubic inch of iron weighs 0.26, or approximately ¼ pound, and therefore one pound of iron will represent 100 ÷ 0.26, or 3.88 cubic inches. A 10-pound weight will represent 10 × 3.88 = 38.8 cubic inches. From this it is apparent that a weight 2 × 2 inches square in cross section will be 38.8 ÷ 4 = 9.7 inches in length. However, the majority of weights are round in cross section and that feature involves further calculation. Assuming that the desired weight is to be 2 inches in diameter the formula for finding the length of a 10-pound weight will be expressed as follows:

$$\frac{38.8}{(2 \times 2 \times 0.7854)} = 12 \text{ inches}$$

The weighing method is much simpler and is practically as accurate. However, it is advisable to make a sample casting from each pattern and weigh it before the job is placed in production. If necessary, a small piece may be cut from the end of the pattern, or a small piece may be glued on the end depending on whether the sample casting indicated that the pattern was a little too long or too short. A follow board is required, made up of two thicknesses of 1-inch lumber nailed to three suitable battens. The lower layer is uniform, but the upper layer is attached in a manner that will provide 10 gaps for the reception of the patterns. The gaps are the proper length for the longest patterns and stopoff pieces are provided to fill the gaps when the shorter patterns are employed. A set gate also is provided, consisting of a straight central runner with a short branch attached opposite each pattern. This gate saves [illegible] cutting gates to each mold and [illegible]ution, gates made in this manner [illegible]e cleaner and more satisfactory than [illegible] cut in the ordinar[illegible]nner by hand. With this method the [illegible] board

FAKED FOUNDRY FACTS

CATCHING UNDER

CHEMICAL ANALYSES OF SPECIAL ELECTRODES

(*Continued from Data Sheet No.* 518)

Uses

For welding mild steel, structural shapes, plates, bars or low carbon steel forgings and castings.

Medium Carbon Steel

Carbon	0.25–0.35 of one per cent
Manganese	0.30–0.60 of one per cent
Phosphorus	(under) 0.04 of one per cent
Sulphur	(under) 0.04 of one per cent
Silicon	(under) 0.12 of one per cent

Uses

For building up worn surfaces that require machine finish, such as wheel flanges, axle collars, etc.

High Carbon Steel

No. 1

Carbon	0.60–0.75
Manganese	0.60–0.90
Phosphorus	not over 0.04
Sulphur	not over 0.04

No. 2

Carbon	0.85–1.10
Manganese	0.30–0.60
Phosphorus	not over 0.04
Sulphur	not over 0.04

(*Concluded on Data Sheet No.* 520)

CHEMICAL ANALYSES OF SPECIAL ELECTRODES

(*Concluded from Data Sheet No.* 519)

Uses

For use on high carbon steels and worn surfaces where great resistance to abrasive wear is desired and where machining is not necessary, such as rails, frogs, switch points, bearing surfaces, etc

Manganese Steel

Carbon	1.10– 1.35 per cent
Manganese	11.00– 14.00 per cent
Phosphorus	.017– .04 of one per cent
Sulphur	.007– .04 of one per cent
Silicon	.10 – .20 of one per cent

Uses

For manganese crossing centers, frogs, switch points, dredge buckets, and other parts where an extremely hard tough surface is required.

Cast Iron

Sufficient data are not available on an electrode of cast iron analysis. Therefore, the chemical composition as given for low carbon iron and steel will govern for the present.

Uses

Cast iron parts studded or general welding.

THE FOUNDRY DATA SHEET, APRIL 1, 1924
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication
Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

HEINRICH TURK, PRESIDENT
KARL TURK, VICE-PRESIDENT
W GRAHAM BOYCE, SEC'Y AND TREAS
EDGAR A WORSHAM, ASST SEC'Y AND TREAS

THE PORCELAIN ENAMEL AND MFG. CO.
OF BALTIMORE

PORCELAIN ENAMELING OF STOVE PARTS, TABLE TOPS AND SPECIALTIES

PEMCO
TRADE MARK REG. U.S. PAT. OFF.

INSTALLATION OF COMPLETE ENAMELING PLANTS ENAMELS AND SERVICE

Baltimore, Md.

June 16, 1923.

The Foundry,
Penton Bldg.,
Cleveland, Ohio.

Att: Mr. J. D. Pease

Gentlemen:-

We feel that at this time we should write and tell you how we feel about our advertising in the Foundry Magazine.

The results obtained from this advertising have been very gratifying to us, and we want to express our appreciation for the co-operation given by your Art Department.

Wishing you success - and the growth of the Foundry Magazine - we are,

Yours very truly,

THE PORCELAIN ENAMEL & MFG CO.

Frank G. Roberts

FGR:LB

FRANK G. ROBERTS

is removed after the drag is rolled over and the cope is rammed directly on the drag. Another advantage of the foregoing method lies in the fact that no special flasks are required. Any flask that will embrace the patterns will serve and on occasion any number of patterns may be removed and small flasks used to mold the remainder. The entire set of one size pattern may be employed or any odd combination may be placed on the board to fill an odd order."

"That will be enough for one night," I said. "Besides, you have omitted to mention the simplest method of all."

"What's that?" said Bill, suspiciously.

"Well," I said, "I never actually have seen the method practiced and for that reason am rather skeptical as to its practicability. In the old *BVD* (Before Volstead Days) I met peg-leg Tim Donovan in Higgin's old saloon on the corner of Lawrence and St. Clair street and after he had surrounded a few tall ones and thereby become properly talkative and confidential he told me of a job he had at one time in a sash weight shop in Chi. He leveled a sand bed every morning, placed a plank across it to support his weight and then stamped rows of molds with his wooden leg. At first he admitted that he depended on chalk marks on the leg to gage the depth, but eventually he became so perfect that he could stamp any size weight merely by instinct."

"You win," said Bill. "I guess it is safe for you to go home."

Investigate Cast Iron

The British Cast Iron Research association in its April report promises publication of results shortly in connection with researches on the solidity of cast iron. Other pending publications will deal with growth of cylinder irons and temperature stresses. A committee is being formed to investigate questions relating to diesel engine cylinder casting. Tests are being carried out in regard to shrinkage defects, and researches have been started on malleable cast iron, cast iron molds for bottle making, and sand. Specifications have been issued for piston rings, piston ring pots and jacketed cylinders for automobiles. Dr. Longmuir, or the secretary, Thomas Vickers, undertake to address meetings in any part of the country by arrangement.

The American Tripoli Co., Seneca, has announced the opening of a St. Louis office at 529 Central National Bank building. Ralph A. Airheart, sales manager, will be in charge. The American Tripoli Co. is a subsidiary of the Barnsdall Corp., New York.

Facing Sand Mixture for Steel Castings

Question: We are thinking of making some light steel castings ranging in weight from 1 to 300 pounds and should like to know if the same facing sand we employ on our iron castings would be satisfactory. If not, will you kindly send us the formula for a suitable facing. We also would appreciate information to assist us in selecting the best material for swabbing the joints and the kind of blacking, if any, used to cover the face of the mold.

Answer: Sand for molding any kind of castings, ferrous or nonferrous, is composed of silica bonded with clay. The only difference between the sand used for steel molding and that used for any other metal, with the exception of monel metal, is that on account of the high silica content necessary the former must be prepared artificially while satisfactory sand for the other metals is found ready mixed in a natural state. Pure silica sand practically is the only material available sufficiently refractory to withstand the heat of molten steel. However, pure silica sand has no bond and therefore cannot be rammed or packed into a definite shape. In your iron foundry practice you are familiar with it under the name of parting sand. Where it is to be employed to form a mold it is necessary to mix it with some agent that will hold the grains together with the least loss of refractory quality. The most convenient material for this purpose is some form of fire clay. For light steel castings about two shovels of silica sand added to a barrowfull of ordinary good molding sand will work satisfactorily. As the weight of the castings increases the relative proportion of silica sand and molding sand changes until it reaches a point where the mixture is practically all silica sand with a small proportion of fire clay.

The only satisfactory method for mixing facing sand for steel castings, or for that matter, facing sand for any kind of castings, is in a mechanical mixer.

The foregoing only refers to the facing sand. The composition of the sand employed for filling the flask does not matter. In the course of time the heap sand will acquire a high silica content from the constant addition of the facing sand and in that manner the amount of new sand gradually can be cut down. The only element that burns out is the alumina or clay and this element must be added constantly in greater or less amounts, depending on circumstances.

Ordinary water is employed to swab the joint before the pattern is removed and finely ground silica is dusted over the molds. Where the molds are skin dried or dried in the oven, the silica flour is applied in the form of a wash. It is mixed with molasses water and handled in the same manner as the familiar blackwash in an iron foundry. Silica flour may be procured through your regular foundry supply house.

A standard facing sand mixture adopted in a prominent middle West steel foundry follows: Old sand 7 pails, new sand 3 pails, fireclay ½ pail. This mixture is thoroughly milled and wet down with plain water. In this respect it is pertinent to point out that green sand for steel molds is worked much drier than sand employed for making molds for iron castings.

Company Leases Foundry

The Menzel & Jeffery Co., Minneapolis, has leased a foundry at 1007-29 South Third street, that city, to be used in the manufacture of sashweights, elevator weights, post mauls, washers, etc. The main foundry at 900-914 Fourth street will be confined to the manufacture of machinery castings. This company is one of the oldest foundry organizations in the Northwest. In 1874 Gregor Menzel started the foundry of G. Menzel & Co., in Minneapolis. Gregor Menzol retired in 1893 and his son, Charles G. Menzel, continued the business as the Menzel Foundry Co. In 1898, J. A. Jeffery became associated with the company forming the present organization of Menzel & Jeffery Co. Mr. Menzel retired in 1919 and sold his interest to J. Frederick Quest. The present officers of the company are J. A. Jeffery, president; J. Frederick Quest, secretary and treasurer and Thomas Mulcahy, vice president and superintendent. Mr. Mulcahy has been superintendent of the foundry for 30 years.

Buys Steel Foundry

The sale of the assets of the Hercules Steel Casting Co., Milwaukee, to the Pawling & Harnischfeger Co., of that city, has been approved by the court. The electric steel casting shop and all equipment, buildings, real estate, etc. have been turned over and the foundry will be opened soon. The foundry has a capacity of 1200 to 1500 tons a month, having one 10-ton electric furnace.

The McMyler-Interstate Co., Cleveland, has removed its Chicago office to 648 Railway Exchange building.

Keeps Tab on Cleaning Costs

Steel Foundry Pays Grinder Hands According to the Amount of Metal Removed—Castings Weighed Before Being Delivered to the Grinder and Again After Being Ground

BY B. K. PRICE

MEASURING wheel performance is one of the most difficult problems in calculating steel foundry grinding costs. Where a large quantity of like castings are produced the problem is less complicated. Such cases, however, are relatively few, as the great majority of foundries do a jobbing business, turning out castings of many diversified shapes and sizes.

Inasmuch as speed, within the proper limits of safety and economy, is the essence of rough grinding, it is natural that one of the first aims of a foundryman is to get a wheel that will cut rapidly. He can, at the same time take every reasonable precaution in making the wheel safe to operate, and in most instances he can tell, after experiments, if one wheel shows economy when compared with another. In the main these calculations are of a general character. Thus, in some cases they result in faulty judgment as to what is really the most economical wheel over a long period. In practically all cases general calculations result in inaccurate cost findings.

Therefore, it is with no little interest, that in describing the cleaning and grinding processes at the plant of the Lebanon Steel Foundry, Lebanon, Pa, attention is directed to the company's cost system, which perhaps is unique in the steel foundry industry. Here, the wheel performance is based on the amount of material removed in pounds with the total cost expressed in terms of cents per pound removed.

Makes Light Steel Castings

The Lebanon Steel Foundry, a pioneer in the manufacture of electric steel castings, and in fact the purchaser of the first Heroult furnace sold by the United States Steel Corp. in this country, has an output of approximately 300 tons per month. The castings are light, ranging from approximately 10 to 20 pounds each. The articles produced are of a widely diversified nature. Between 400 and 500 different parts are cast for railroads, and close to 200 for automobile and motor truck manufacturers. In addition, the company manufactures castings for machine tools and for many other lines that fall to the lot of the general jobbing foundry. It is apparent, therefore, that the diversity of the product is such as to afford a cost system a real test.

In arriving at the total cost per pound of material removed, wheel cost, labor and overhead are the three principal factors, with time an important element. The men are paid on the basis of pounds of material removed and their earnings are substituted for what would otherwise be so many hours at so much an hour. In making a comparison of wheels, an arbitrary figure for overhead is used. This figure must not be permitted to vary, as otherwise the cost of performance would be thrown out.

The following hypothetical example will serve to illustrate the method employed: Assume that the material removed by an 18-inch wheel is 400 pounds, and that the cost of the wheel is $20. Assume again that the earnings of a man at 6 cents per pound of material to be six times 400, the equivalent of $24. Assume further that the wheel lasted for three days of 10 hours each, or 30 hours, and that the overhead was $1.50 per hour. Add these elements together—wheel, labor and overhead—and divide by the pounds of ma-

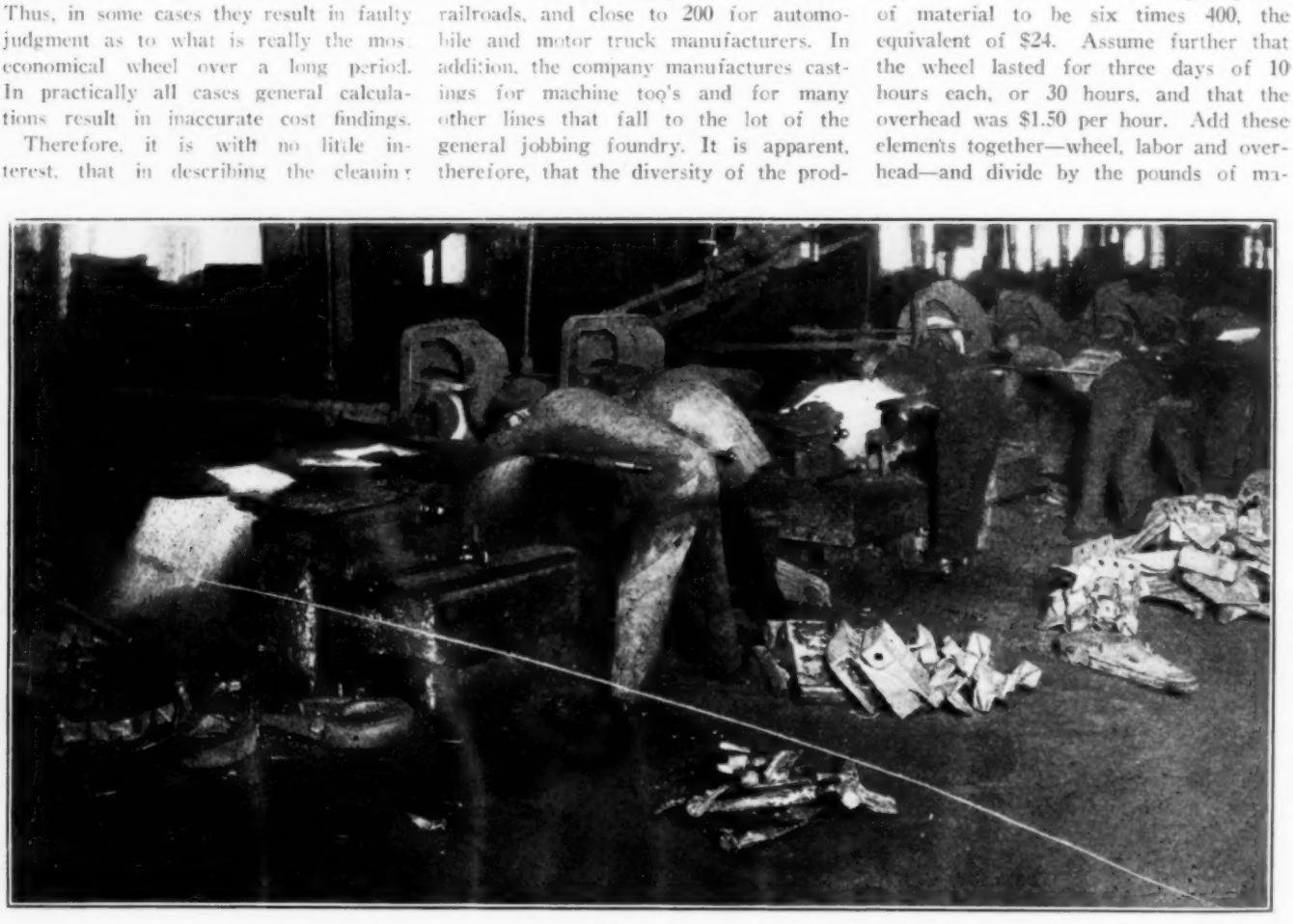


FIG. 1—LARGE STEEL CASTINGS ARE GROUND UNDER SWING-FRAME MACHINES

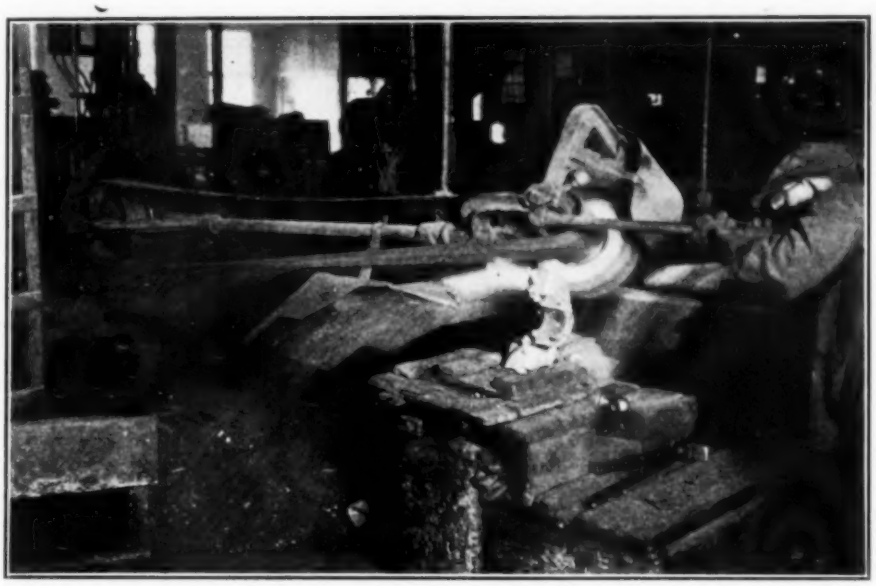


FIG. 2—THE WORK IS HELD IN A VISE LOCATED ON A WORK TABLE

terial removed, and the answer will be the cost per pound of material removed.

In paying the men, the basis is set regardless of the kind of work ground. The men who operate floor grinders receive a higher rate than is paid those on swing-frame machines. This is due to the lighter character of the work, but this is the only variance. A man on a swing grinder at the Lebanon plant, incidentally, removes on an average from 125 to 150 pounds of material in an average working day of 10 hours. To establish the amount of material removed, the castings are weighed before and after being turned over to the grinders. If the operator can remove a snag or a piece of rough metal by flogging and thus do it quicker than by use of the wheel, he is permitted to do so. All in all, the plan has worked out satisfactorily for both the employes and the company. It has stimulated production and increased wages in much the same manner as piece-work, but it does away with the dissatisfaction that often arises due to the difference in the sizes and nature of the various pieces. At the same time, it is conducive to more accurate cost finding.

The equipment at the Lebanon plant includes 11 swing-frame grinders built by the company and illustrated in Fig. 1. Nine of these are driven by a line shaft of 50 horsepower, while two are driven by individual motors of 10 horsepower each. As shown in Fig. 2, the work is held in a vise, with the wheels mounted between safety collars. In this particular instance the work on the machine is a spring hanger for an automobile truck. Owing to the importance of keeping the wheel spindle bearings in good condition, they are of generous size and are so mounted that they are easily accessible. Attention to this point has resulted in true wheels and consequently a minimum amount of dressing.

FIG. 4—SURFACES THAT CANNOT BE GROUND ARE CLEANED BY CHIPPING

FIG. 3—SMALL CASTINGS ARE GROUND ON HEAVY FLOOR MACHINES

To keep the wheels at a constant surface speed, the swing grinders are segregated into three groups of different speeds. Supplementing these machines are seven stationary heavy duty type stands, mounted with 24-inch artificial alumina wheels 2½ and 3 inches wide respectively. Fig. 3 illustrates this type, with the operator on the right grinding a cutting plate for a feed mill, similar to the casting shown in the lower foreground.

One group of swing grinders also is equipped with 24-inch wheels of a similar type. These wheels, mounted on either type of machine, are operated at 955 revolutions per minute until worn down to a diameter of 18 inches when

they are changed to other machines and driven at 1275 revolutions. When worn to a diameter of 14 inches, they are again changed and operated at 1600 revolutions until reduced to seven inches, at which point they are discarded. Under such circumstances the surface speed naturally varies. However, at the beginning of each of the three stages it is approximately 6000 feet.

It has been the experience of the Lebanon Steel Foundry that wheels of artificial alumina from 12 to 16 grit and in hard grades in different combinations are best suited for its particular kind of work. These wheels, it is estimated, should run from 2 to 3 cents per pound of material removed. In the case of an 18 x 3-inch wheel of this type it should remove from 350 to 450 pounds, before it had outlived its usefulness, depending upon the grain, grade, the operator and the care exercised in use. The cleaning process begins in the sandblast room. Steel shot is used and a rotary table is employed which permits setting the castings on one-half of the table, while those on the other half are being cleaned. The larger gates and shrink heads or risers are then removed either by flogging or by oxy-acetylene torches, while the smaller gates are sheared off on a sprue cutter.

Subsequently, the work is delivered to the grinding machines and then to the chippers, where the interior surfaces are cleaned and if the castings reveal any imperfections they are prepared for the welder. Fig. 4 shows the chipper working on a flange for a motor truck. On the table is to be noted a wide variety of castings, typical of those produced at this plant.

Following the chipping and welding operations, the castings are annealed. They are then placed in tumbling barrels, which removes annealing scale and imparts a polish to the castings, so much desired by users of small steel cast parts for various industrial purposes.

Issues New Bulletin on Sand Blast Units

The J. W. Paxson Co., Philadelphia, has issued a 48-page booklet describing types of sand blast equipment and dust collectors. The various sand blasting machinery described include the hose barrel, tilting, automatic and the sand blast table cabinet types. Various equipment used in conjunction with sand blast rooms such as elevators, tables, railroad cars, etc., also is described. Safety devices such as helmets, eye protectors, and gloves are shown. The booklet is well illustrated with views of various types of machines and a number of installations.

Sand Employed for Both Brass and Iron

Question: About twice a week we take off a small brass heat to pour water fronts and small tank heaters. Our heater molder puts this work up on a floor where he makes cast iron sections the remainder of the time. Recently his loss on cast iron sections has been unusually high and he claims that the loss is due to using the same sand for both brass and iron heaters. Will you kindly advise if there is any basis for a claim of that character.

Answer: Like many other questions that constantly are turning up in the foundry this is one that cannot be answered by a direct yes or no. However, in a general way it may be stated that the act of pouring brass castings one day will not affect the sand adversely or result in defective iron castings the following day. Where the molder is familiar with the peculiarities of both brass and iron he will experience no trouble in making castings of each kind side by side in the same sand heap. This practice is quite common in small foundries and in many general jobbing shops where the volume of brass castings does not warrant the operation of a separate department. The fact that a finer grade of sand is considered necessary for the production of brass castings is due to the fact that usually the castings are light. The same class of sand would also make satisfactory iron castings.

The impression of some molders to the effect that brass and iron castings cannot be made in the same sand is due to lack of observation. The size and shape of the casting exercise an important bearing in any discussion on this subject; but as a general rule it may be stated that sand may be rammed a little harder for brass castings than it may be for iron. On the other hand the sand employed for making iron castings may be worked a little damper than the sand for brass castings. Neglect to observe these two cardinal features is responsible for practically all the trouble experienced when casting both metals in the same sand.

Many otherwise competent molders develop a uniform method of ramming and ram the sand in all their molds to the same density. So long as they continue making castings of the same general characteristics this method is satisfactory, but when they attempt to make a casting differing radically in shape, size and metal thickness from those to which they have been accustomed, the result is a failure. A notorious example of this is the case of the man accustomed to dry sand molding either in iron or steel. His first attempts in green sand invariably fly to the roof. He has become so accustomed to hard ramming that he considers it necessary.

The same holds true of handymen broken in to work on machines. They are taught to ram their first molds to a certain density and so long as they remain on one job, no trouble is experienced. Later, if the pattern and flask are changed, it sometimes is surprising what a pile of scrap they can turn out before they attain their former satisfactory record.

You do not state the exact cause of your losses, but we are inclined to the opinion that your molder unconsciously rams the sand too hard in his iron molds. Of course, it is possible that he adds a considerable quantity of fine new sand to the heap on the days he makes the brass castings and overlooks the fact that brass will lie closer than iron to fine sand. If that is the case the necessity for light ramming in the molds for the cast iron sections is more pronounced than ever.

Survey Refractory Uses

A meeting of the committee on refractories of the American Foundrymen's association was held recently at the Hotel La Salle, Chicago. At this meeting various phases of the standardization of refractories in steel, gray iron and malleable foundries were discussed as well as the best method of proceeding. A general survey of the various uses of refractories in foundries will be made by members of the committee and data collected will be submitted to the ceramic division of the bureau of standards, Washington, which will report back to the committee with definite recommendations as to methods of procedure. Meanwhile the subjects under consideration will be handled by correspondence and a definite contact will be made by the secretary of the committee with the ceramic division of the bureau of standards, Washington.

Book Review

Standard Practical Plumbing; by R. M. Starbuck; cloth, 421 pages 6 x 9 inches, published by the Norman W. Henley Publishing Co., New York, and furnished by THE FOUNDRY, Cleveland, for $3.50 net.

This work is a treatise on the different branches of plumbing construction including drainage and venting, ventilation, hot and cold water supply and circulation. The book is written in simple language and goes into detail on the latest and best plumbing practice, special attention be-

ing given to the skilled work of the plumber and to the theory underlying plumbing devices and operations.

Chapter XIX will appeal particularly to maintenance engineers interested in plumbing for factories whose problems are more or less complex. A chapter is devoted to the examinations for plumbers and fitters to meet the requirements of laws enacted in different states. Another section gives some of the features of government plumbing, and the specifications covering plumbing construction in public buildings. The text is illustrated throughout by a large number of line drawings which adds to the interest of the book.

Rapping Plates Required on Patterns

BY M. E. DUGGAN

GOOD patternmaking practice favors the use of rapping plates and drawing plates on all patterns. Of course, this does not apply to patterns that are placed on molding machines, match-plate patterns, or patterns that are mounted in vibrator frames.

Discretion should be exercised in a case where only one casting is ordered from a pattern and unless the pattern is unusually deep, necessitating the use of long lifting straps to pull it out of the sand, rapping plates are not required.

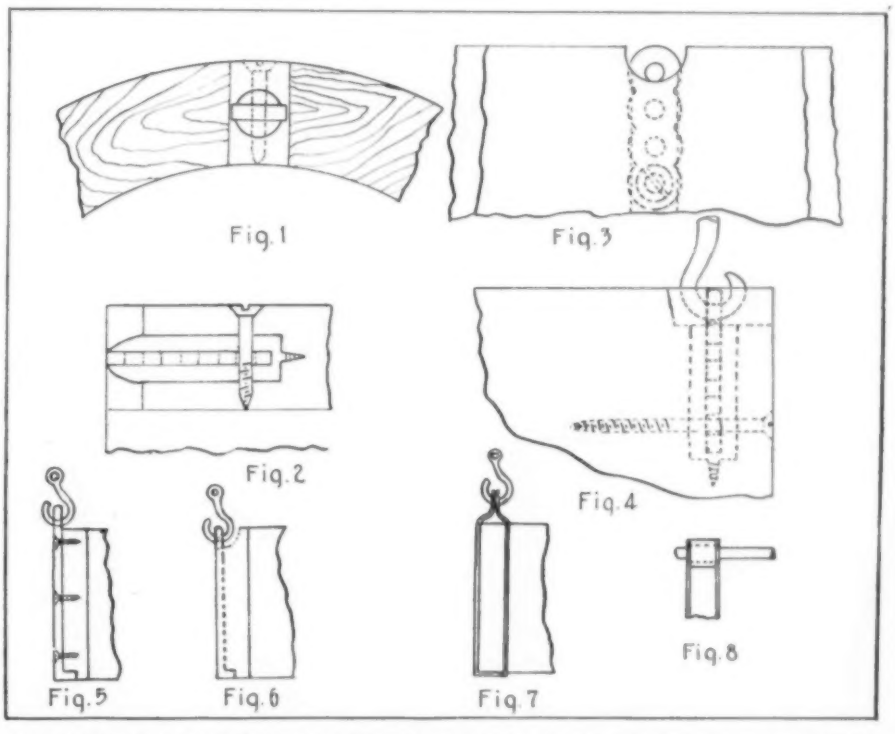
Many methods are followed in making and attaching long lifting straps to patterns. Some patternmakers use a single strap of various widths made from ⅛ inch or 3/16 inch steel strip. The bottom end is turned at a right angle under the pattern and a hole for the hook is provided at the upper end which extends above the pattern. A recess is cut in the face of the pattern to accommodate the thickness of the strap and the strap is held in place by a number of wood screws driven through countersunk holes. In the main this method is satisfactory especially if the pattern is to be molded in the floor, but if the pattern is designed to be molded in a drag and rolled over, the projecting ends of the straps catch on the rollover board. The molder either will have to place strips corresponding to the height of the strap projection, between the board and the edge of the flask, or cut holes in the rollover board to receive the ends of the straps. The style of strap shown in Fig. 6 does away with any trouble of this character.

Objection advanced against this method is based on the fact that an unsightly gap is gouged in the pattern to receive the lifting hook. Finicky patternmakers claim that the gap detracts from the finished appearance of the pattern. Experience gained over a long period of years teaches that altogether too many patternmakers place the finish of a pattern ahead of the molder's requirements or even in extreme cases, consider it of more importance than the production of the casting.

Straps for a pattern with a thin and deep section are made from band or hoop iron. They are carried around the bottom, up both sides, riveted in place and the two upper ends containing the holes for the lifting hooks are joined as illustrated in Fig. 7. An alternative method is shown in Fig. 8 where a space block is placed between the ends.

Simple and in many cases unimportant details, polish on the pattern, depth of recess for the lifting hook, thickness of block between the strap ends frequently are a source of worry to the apprentice and occasionally to the journeyman patternmaker. The only cure for a patient of this kind is a trip to the foundry where he can observe details of actual foundry practice and also where he may note the manner in which the molder and coremaker make use of the lifting appliances.

One of the ordinary rapping plates usually attached to the surface or inset its own thickness in the face of a pattern is shown adapted as a lifting strap in Figs. 1, 2, 3 and 4. The pattern in this instance is for a ring 12 inches deep and 1⅜ inches thick. The rapping plate is 2¼ x ¾ inches. A half circular groove was cut across the top of the ring and then a ⅝-inch hole was bored down into the pattern 2½ inches. The plate first was placed on the outside of the pattern and the position of the screw holes marked. After a hole had been drilled for the bottom screw the ¾-inch wide plate was forced into the ⅝-inch hole thus locking it firmly in place. A screw driven through the bottom hole finished the anchoring process. The screw first was dipped into thick shellac.



VARIOUS APPLICATIONS OF LIFTING STRAPS, ALSO THE MANNER IN WHICH AN ORDINARY RAPPING PLATE MAY BE ATTACHED TO SERVE AS A LIFTING STRAP ON A DEEP PATTERN

Discovers Method for Isolating Titaninum

Isolation of titanium on a commercial scale has been made possible as a result of research work conducted for the past several years by Simon J. Lubowsky, research engineer, of the Metal & Thermit Corp., New York, according to a statement of this company. This metal, which heretofore has been obtainable only as a laboratory

curiosity, now is to be had in commercial quantities.

The principle of this new method of isolation is applicable on a commercial scale to many of the rare elements, although Mr. Lubowsky has carried his work to completion only in respect to metallic titanium.

Mr. Lubowsky, who is preparing a technical paper on his discovery which will be presented shortly before various scientific societies, is a graduate in chemical engineering of the Carnegie Institute of Technology, Pittsburgh, and has been connected with the Metal & Thermit Corp. since 1915. During the war, he was in charge of the chemical work carried on by this corporation.

Saves Riser Metal in Casting Steel

BY W. A. JOHNSON, SR. AND WM. H. ALBOHN

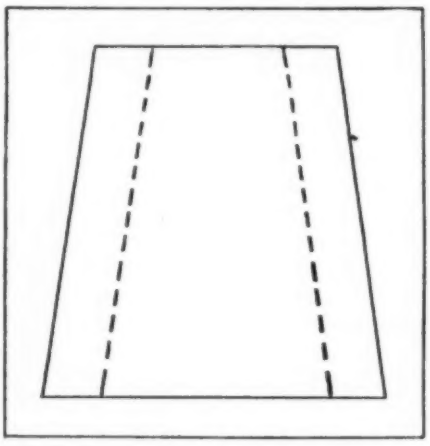
GRAY iron foundrymen, who long ago discovered the uselessness of large and expensive risers on castings, wonder at the large risers employed on steel castings. In the latter work the structure and high shrinkage qualities of the metal involved necessitate large risers, some of which may be heavier than the casting itself. Owing to the large amount of metal involved and the high percentage of remelt resulting from such risers, the advisibility of cutting down the riser head to a point where an actual saving will take place often has been discussed. However, this saving must accrue without jeopardizing the value of the casting. In other words, the casting must be sound at all points so far as shrinkage is concerned, and the services of the welding and reclaiming department must not be necessary.

Perhaps the cost of welding shrinks has kept many foundrymen from experimenting extensively with various sizes of risers. The general practice has been to stay on the safe side at all times, and in keeping on the so-called safe side, risers have been used beyond the size actually needed. Every pound of metal included in the riser beyond the amount actually needed constitutes a loss to the foundry. The loss is distributed through shrinkage in melting, rehandling and remelting. Even 5 per cent in the riser loss will amount to a considerable sum in a short time.

In the case of electric steel, with a return in the form of risers of 25 per cent or better, the large percentage of steel returned to the furnace becames a serious problem. The method to be explained has been in use for several years in a steel foundry melting by the converter and electric furnace method, and has been found satisfactory in the saving effected and the quality of castings made.

The size of riser has been decreased by using a cone core riser. The large end of the cone is placed next to the neck of the riser. In many cases the neck of the riser is incorporated in the so-called riser core and is rammed in the cope when most convenient. Mixtures used in cores are the same as those employed in regular runner boxes or cut-core, sand mixes, the cores are produced easily and rapidly with little expense incurred in the manufacture of boxes. Different sizes of risers are secured with the same outside measurements of the core by using a different size core block to form the recess in the core. The loss of the cores used constitutes only a small item compared with the actual saving in molten metal. The accompanying sketch shows a cross section of the core used.

The reason for the core riser is apparent. It gives a greater body of molten metal at the point where it is most needed. A much smaller surface of metal is exposed at the top of the riser. This allows the metal to remain in the molten state for a longer time and permits the metal to feed in the amount needed. In a riser of this type the shrinkage takes place in the center of the riser, and owing to the construction, feeding the casting is accomplished in a more natural manner. The cone shape saves the amount of metal involved in carrying the riser straight up, which in many cases amounts to 25 per cent or more of the metal needed for the riser formerly used. Although the metal is of greater volume in the straight side riser, the design is such that the metal does not feed readily in the neck of the riser. The large surface of metal at the top of this type of riser cools rapidly, and is of no value in furthering proper feeding. For these reasons it may be seen that the cone shape riser gives better feeding without excess metal.



A SMALLER SURFACE OF METAL IS EXPOSED TO THE ACTION OF THE AIR

The length of the riser core, depending on the casting to be fed, is from 6 to 12 inches. The standard used for the riser opening in the core is as follows:

Bottom 10 inches; Top 7 inches
Bottom 8 inches; Top 5 inches
Bottom 6 inches; Top 3 inches
Bottom 4 inches; Top 2 inches
The core walls are from 1½ to 2 inches thick.

Core boxes for this type of riser may be built easily and with small expense. The main object of the method is to save metal and to have the metal used do the proper work.

Asks for Bulletin

A paragraph was published in THE FOUNDRY some time ago summarizing the contents of the British Cast Iron Research association bureau bulletin. This association has its headquarters in Birmingham, England, and the bulletin is useful for its summaries of the recent papers of practical and worldwide value. As the result of the paragraph mentioned over 40 applications were received by the secretary for copies of the bulletin, the applicants being members of numerous technical associations in America and other countries, other correspondents being leading members of well known universities. The next bulletin will be published soon.

Reprints Paper

The Reliance Electric & Engineering Co., Ivanhoe road, Cleveland, has prepared for distribution a paper "Anti-Friction Bearings in the Steel Mill" presented by the chief engineer of that company, A. M. MacCutcheon, at a recent meeting of the Association of Iron and Steel Electrical Engineers.

The meeting night of the Chicago Foundrymen's club, Chicago, has been changed from the second Saturday to the second Monday of the month.

Filter Gates for Forge Iron Castings

Strainer gates made of dry sand and placed in the runner are used considerably in American automobile cylinder foundries in order to assist in producing sound castings. They have not been employed to any extent for larger castings for which the skim gate or swirl gate still finds favor in cases where it is desirable to trap impurities. Cesare Brunelli, an Italian foundry engineer at Bergamo, Italy, has developed a system of strainer gates, or filters as they are called, for both medium and heavy castings. The general construction of one of these filters and its application to a roll casting is shown in Fig. 2. The filter is also used in Italy for purifying steel in the manner shown in Fig. 1 In the case of iron castings the Brunelli filter is placed over the runner in the position ordinarily occupied by the pouring basin which it supplants. When used in a steel foundry the filter is rammed up in a separate ladle through which the metal is passed on its way from the furnace to the crane ladle. Filters of various sizes are used for castings of varying weights. Mons. Brunelli has prepared a series of drawings and detailed designs applicable to different classes of work.

One of the chief claims made for this system of pouring is that it obviates the necessity for any risers on large iron castings and also eliminates churning or feeding heavy castings after they are poured. In addition Mons. Brunelli claims that the absence of risers in conjunction with the filter gate considerably reduces the oxidizing effect of the atmosphere. The metal entering the mold is oxidized in proportion to the volume of air with which it comes into contact. In molds containing large open risers a circulation of air is set up by the differences in temperature resulting from the pouring operation, which it is claimed greatly increases the oxidation. Experiments have indicated that in the case of a large casting with a metal section of 13/16-inch and with a single ⅝-inch riser, the air in the mold was changed or renewed 14 times during the pouring operation. Most of this air entered through the unobstructed runner and gate which was ½-inch in minimum diameter and passed out through the riser. In addition risers represent a waste of metal and fuel.

When the filter is used for casting rolls as shown in Fig. 2, it is claimed that the feeding operation through an open riser is completely eliminated. Some Italian foundrymen making rolls have had some trouble with the quality of the metal in the upper roll neck when casting in the ordinary manner. With the filter gate it is claimed that these difficulties are overcome and that the length of the full sized riser *X*, Fig. 2, in which impurities are collected, can be considerably reduced. Under this system of pouring the metal falls directly into the mold as shown, thus eliminating the use of the open riser and bottom gate. The direct flow of metal into the mold has a tendency to give a more homologous casting.

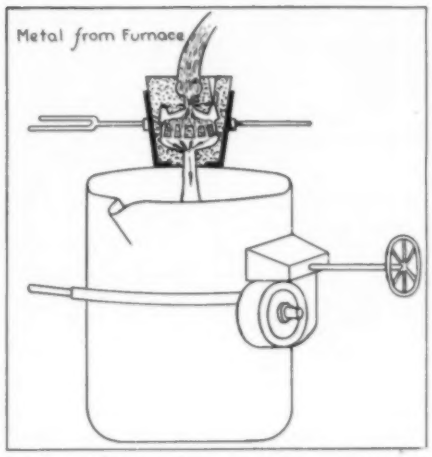


FIG. 1—HOW THE FILTER GATE IS USED IN AN ITALIAN STEEL FOUNDRY

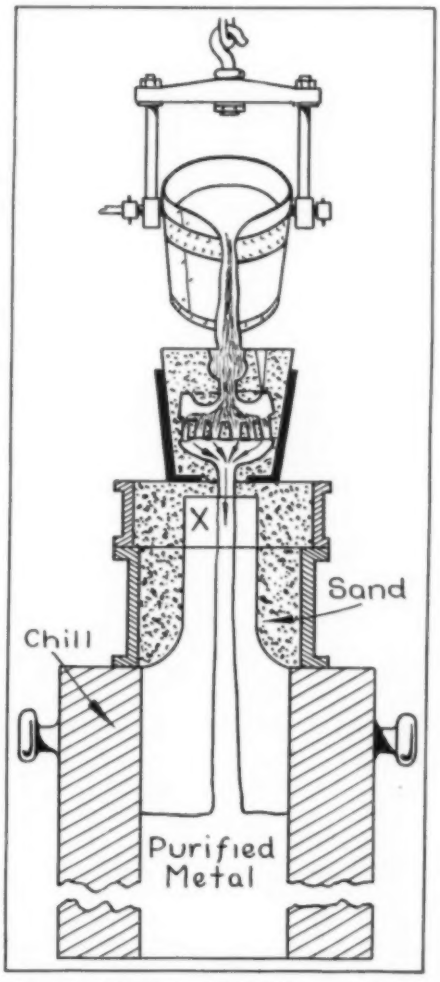


FIG. 2—SKETCH SHOWING APPLICATION OF FILTER GATE TO MOLD FOR LARGE IRON ROLL

Cause of Rat Tails on Light Castings

Question: We are troubled to a considerable extent with rat tails on some of our light flat work and will appreciate your opinion on the cause of this peculiar phenomenon. We are attaching a sketch showing a typical casting with the location of the gates and the rat tails marked thereon. The molds are made in fine Albany sand and are not faced. The castings are poured from a mixture made up of five kinds of pig iron, three machine cast and two sand cast. The charges are made up in the proportion of 2500 pounds pig iron and 1500 pounds foundry scrap.

Answer: Rat tails have furnished a prolific topic for discussion ever since thin castings first were attempted. Usually they are regarded as the most mysterious of the many mysterious accidents that happen to castings. They will appear one day and disappear on the following day for no apparent reason and without any change in the usual practice. However, there is a cause for everything although in many cases a long diligent hunt is required to find it. The only way to trace your trouble to its source is by a process of elimination. Rat tails may be due to several causes and in addition foundrymen frequently confuse plain cold shuts with rat tails. From the sketch which you have submitted we are partly inclined to the opinion that yours is a cold shut problem. True rat tails rarely manifest themselves in straight lines or in regular patterns or in exactly the same position on duplicate castings. They are formed by little mounds of dust created by the surge and wash of the metal in filling the mold. This dust usually results from using a light blacking, one that does not stick to the sand. Occasionally the dust is washed in from a dry runner. The fact that you show straight lines leading from each branch gate and the further fact that you do not use facing on your molds inclines us to the opinion that the marks to which you refer are not rat tails, but represent the junction line between converging streams of iron a little on the cold side. The remedy for this condition is to pour the iron hotter, or, provide wider gates and more of them so that the iron will enter in practically an unbroken sheet.

H. W. Fernald, for a number of years resident manager of Rogers, Brown & Co., at Boston, has resigned to become affiliated with Reed, Fears & Miller, Inc., at Boston. Mr. Fernald will continue to be identified with the sale of pig iron in New England. The office is at 141 Milk street.

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Shovel Plays Important Role

THOMAS D. WEST in one of the early editions of his *American Foundry Practice* devoted a chapter to a description of the proper method of preparing sand. He emphasized the important part sand conditions play in securing satisfactory castings and stated that the molder should be as competent in judging the quality of his sand as the painter is in mixing his colors or the apothecary is in compounding his pills to produce a certain result. Every trade has its technique and the late Mr. West was drawing from an intimate, detailed experience extending over a period of many years when he stressed the point that the embryo molder's first effort should be to learn how to manipulate a shovel in a workmanlike manner.

Cutting over a sand heap is no child's play. In fact, to the beginner it is a back breaking experience. The average man is not ambidexterous. He is naturally either right or left handed. A familiar example even to those who have no experience in the manipulation of manual tools is presented in the ball parks. The players are divided into two classes, those who stand at the right and those who stand at the left of the home plate when batting. Each man instinctively grasps a bat in a certain manner and never changes during his entire active career. The beginner in a foundry follows the same rule or instinct in grasping a shovel handle. One of the first things he is forced to cultivate is the ability to change hands so that he may shovel sand from either side with equal facility. Necessity and expediency both are responsible for this part of his education. Necessity forces him to change hands to prevent undue strain on his arms and enables him to shovel continuously without indulging in a rest period. One set of muscles in the hand and arm is brought into play when a man shovels right handed and a different set of muscles is exercised when he shovels left handed. By alternating from side to side, each set is rested without interfering with continuity of operation. With sand spread over a floor area 6 to 10 feet wide it is practically impossible to pitch the sand into a long, straight, continuous pile if the molder shovels consistently from only one side. The objection might be advanced that the shape of the sand heap is a matter of minor importance if the sand is properly mixed; but foundries, have their standards of excellence and a straight sand heap in the center of the floor is regarded as a measure of a molder's proficiency.

Conditions in the foundry have changed to a considerable extent during the past 10 years. Many foundries have installed mechanical sand handling equipment which prepares the sand in immense quantities and delivers it to the molders fit to use. This is particularly true where power operated molding machines are employed extensively. In other plants where conditions warrant, some form of portable sand conditioning apparatus is employed which travels over the floor and either leaves the sand in the familiar long heap or throws it into one large heap close to a stationary machine. At least one machine has been developed during the past few years which not only prepares the sand but also fills the flask and packs the sand into place without any of the usual forms of ramming equipment. However, in all probability many years will elapse before mechanical sand handling equipment will be adopted universally in the foundry industry or before the last faithful old shovel is oiled for the last time and put away permanently in a glass case labeled "obsolete foundry tools."

Trade Outlook in the Foundry Industry

INCREASED manufacturing activity has featured the farm implement industry during the past 30 days. Manufacturers have been in the market for steel requirements on a scale not equalled in many months. This increased production activity is in response to a heavier demand for implements to be used in spring farming than was evident during the early winter months at which time orders usually are placed. While dealers are showing a stronger buying tendency it still is evident that they are buying only on actual prospects.

The South has been buying even heavier than generally was expected while agricultural states further north also are coming into the market. Signs of revival in the tractor business are apparent. Both of the leading tractor manufacturers are enlarging their schedules for 1924, 50 to 100 per cent.

Large Car Orders

Recent heavy buying by various railroad interests is an encouraging factor in the market. The number of cars ordered in February was 41,346. With the exception of March 1923 this was the largest total for any month since 1918. These large purchases partly reflect the unequaled winter traffic totals. During February the record of weekly car loadings ran 8 per cent ahead of the previously unprecedented February freight movements of last year.

Prices for Raw Materials for Foundry Use

CORRECTED TO MARCH 24

Iron		Scrap	
No. 2 Foundry, Valley	$25.00 to 26.00	Heavy melting steel, Valley	$19.50 to 20.00
No. 2 Southern, Birmingham	22.50 to 24.00	Heavy melting steel, Pitts.	19.00 to 19.50
No. 2 Foundry, Chicago	24.50	Heavy melting steel, Chicago	16.00 to 16.50
No. 2 Foundry, Philadelphia	23.63 to 23.76	Stove plate, Chicago	18.00 to 18.50
No. 2 Foundry, Buffalo	21.50 to 22.00	No. 1 cast, Chicago	21.00 to 21.50
Basic, valley	22.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	21.50 to 22.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	24.50	No. 1 cast, Buffalo	20.00 to 20.50
Malleable, Buffalo	21.50 to 22.00	Car wheels, iron, Pittsburgh	20.00 to 20.50
Coke		Car wheels, iron, Chicago	19.00 to 19.50
Connellsville foundry, coke	$4.75 to 5.50	Railroad malleable, Chicago	21.00 to 21.50
Wise county foundry, coke	5.00 to 6.00	Agricultural mal., Chicago	19.25 to 20.25
		Malleable, Buffalo	20.50 to 21.00

February brought another increase in pig iron production. The average daily output was 105,700 tons. This was the highest daily production since August in the preceding year. The gain in February over that for December was 13 per cent. Last year the February record only exceeded that of the preceding December by 7 per cent. The number of active blast furnaces at the close of February showed an increase of 14 during the month. Further gains are indicated for March. Although shipments of pig iron continue on a fair basis, buying for the second quarter of the year is below expectation. Pig iron producers in some districts are offering concessions. The upturn in industrial activity which became evident during January has continued into March, but the enthusiasm of early February has moderated slightly. Exceptional activity in several fundamental industries has served to emphasize the fact that conditions in several other important industries are extremely dull. An extremely cautious attitude toward future commitments which characterized the latter half of 1923, again is appearing to be adopted as a general policy. Revival of this conservative policy insures the continuance of moderately active profitable business throughout the spring and early summer months. Also it effectively eliminates the possibility of a period of speculative expansion which characterized former similar periods.

Furnaces Are Active

Outputs in the motor car industry have broken all seasonal records and now approach if they do not equal the great production peak of last August. Sales are high, but not as large as the output and as a result stocks are accumulating at the factories and dealers store rooms. Manufacturers are pursuing a cautious course respecting the future and raw material purchases are being held to a strict minimum. Competition is intensely keen and high costs have forced a few companies to increase prices. These outstanding features of the automobile situation shed but little light on the general outook. The future depends on the ability of the country to absorb the ever increasing flood of new cars.

Record Production

Railroad car buying continues active. The Chesapeake & Ohio has an inquiry for 5600 cars and the Louisville & Nashville has placed an award for 3900 cars. The Chesapeake & Ohio inquiry calls for 3000 all steel hopper bottom gondolas, 2000 double sheathed automobile box cars and 600 Hart ballast cars. Purchase of equipment for the railroads has constituted the greatest single factor in the impetus given industrial activity. Repair equipment figures prominently in the total volume of railroad orders and inquiries. February car orders seem large by comparison with recent lean years for the railroads. In the prosperous prewar days large monthly totals were not uncommon. Competent authorities estimate that at least 200,000 cars will be required annually for a period of 10 years to keep pace with normal expansion in industry.

Orders for cast iron pipe, pressure pipe in particular show no let up and the several large pipe shops in the South are adding steadily to their tonnage. Assurance is growing stronger that increased activity will continue for many months. Soil pipe manufacturers are busy. Shipments of all classes of sanitary ware show an increase over a corresponding period last year. New orders for enameled bath tubs totaled 137,246 as against 107,494 in January. Steel casting business is reported slow in many sections.

Franc Has Recovered

The severe break in London metal prices which has obtained during the past few days, generally is regarded here as a direct reflection of the effects of the American-British loan to France. According to the monthly report of the state association nonferrous operations in Ohio have increased from 62 2/3 per cent of capacity in January to 66 per cent in February. New York quotations on nonferrous metals according to the *Daily Metal Trade* of March 22, follow: Casting copper, 13.50c; electrolytic copper, 13.87½c; Straits tin, 56.25c; lead, 9c; antimony, 11.50c; nickel, 25-30c; aluminum, No. 12, open market, 23.50-24c. Zinc is 6.50, E. St. Louis, Ill.

Comings and Goings of Foundrymen

AMBROSE G. WARREN, chief engineer and general superintendent of the J. W. Paxson Co., Philadelphia, manufacturer of foundry supplies and equipment, has resigned and now is affiliated with the Aetna Foundry Co., of that city, in the capacity of vice president and treasurer. He is also vice president of the Pennsylvania Bronze & Brass Co., Philadelphia. Mr. Warren will devote part of his time to consulting engineering, specializing in the design and operation of iron and brass foundries.

F. J. Ryan, F. J. Ryan & Co., Philadelphia, addressed the Philadelphia Foundrymen's association in that city, March 12, on the subject of "Annealing of Cast Iron."

George H. Manlove, former secretary of the Chicago Foundrymen's club, who recently removed to Cleveland where he is associate editor of *Iron Trade Review*, has been made an honorary member of the Chicago club.

Frederick K. Vial, chief engineer of the Griffin Wheel Co., Chicago, and consulting engineer of the Association of Manufacturers of Chilled Car Wheels, addressed the Chicago Foundrymen's club at the Chicago City club, March 10.

Carl B. Lockhart, General Electric Co., Erie, Pa., addressed the meeting of the Pittsburgh Foundrymen's association held Monday evening, March 17, on "Modern Methods of Cleaning Castings."

August E. Steffen recently was elected president of the American Sash Weight Foundry Co., Davenport, Ia. Charles E. Robeson was elected vice president, Mathias E. Steffen secretary and Dr. Kuno Struck, W. J. Blunk, H. Burrman and B. F. Aufderheide Jr., directors.

T. R. Harrison, formerly associated with the bureau of standards, and more recently with the Champion Porcelain Co., Detroit, has been placed in charge of the research department of the Brown Instrument Co., Philadelphia.

James Rountree, for 14 years foundry superintendent of the American Locomotive Co. will be in charge of the operations of the Ward Railway Equipment Co., Lima, O., recently incorporated to manufacture safety and time saving appliances for railroads.

Newton Morris has taken over the share of his brother, Oscar, in the Morris Brothers Foundry, Fond Du Lac, Wis., and will operate the shop under the name of Morris Foundry. A new 42 x 72 foundry addition and fire proof pattern storage vault have been completed.

Thomas Vickers has resigned as secretary of the British Cast Iron Research association, a position he has held since 1919. Mr. Vickers has been prominent in the British foundry industry for many years and in addition to having been one of the prominent factors in the organization of the Cast Iron Research association, he was secretary of the Birmingham Metallurgical society for some time and is a member of the council of the Institute of British Foundrymen. He was also the principal organizer of the first foundry equipment exhibition which was held in Birmingham, England, in 1922.

Plan for Convention

In preparing for the ninth annual convention of the National Association of Purchasing Agents to be held in Boston, May 20-23, committees are preparing a program in response to suggestions submitted by members. Voting cards send out to members and returned in large proportions point the way to the desires and needs of purchasing agents from all parts of the country. One of the features of the convention will the exhibition which is to be held in conjunction with it. Exhibitors at the show will be those whose lines will appeal to purchasing agents from an educational standpoint. The convention combined with the show will make up a most intensive course in theory and practice. Information and reservations for the show are being handled by W. L. Chandler, 19 Park Place, New York, or J. Arthur Gibson, Simplex Wire & Cable Co., 201 Devonshire street, Boston. Convention details are being arranged by H. J. Graham, 80 Boylston street, Boston.

Refractories Form Topic

The spring meeting of the American Electrochemical society will be held in Philadelphia, April 24 to 26. A round table discussion on "Refractories for Electric Furnaces" will feature one of the meetings. The introductory talk will be given by Dr. Alfred Sansfield, McGill university, Montreal. M. L. Hartman, Carborundum Co., Niagara Falls, N. Y., will be chairman of the meeting at which this subject will be discussed.

Malleable Iron Producers Form Organization

On Feb. 22 an association of French, Belgian and Luxemburg producers of malleable iron was formally organized in Paris under the name of the Association d'Etude de la Malleable. The society has been organized as a corporation with head offices at 6 rue Franklin, Paris. This new institution, which is modeled on the lines of the American Malleable Castings association, is largely the result of the efforts of Marcel Remy, producer of malleable iron castings at Herstal-lez-Liege, Belgium, the preliminary arrangements having been made during the foundry congress which was held in Paris in September, 1923, as reported in THE FOUNDRY, Oct. 15, 1923.

The founders of the *Association d'*-Etude de la Malleable include: M. Theret, managing director of the Founderies Vve.; Gaston Theret, Ivery-S-Seine; Mr. Gustin, Paris; M. Cury, Ardennes, France; M. Martin, Ardennes; M. Daugenet, Founderie des Ardennes, Mazieres, France; M. Henry, Forges et Founderies de Gennevilliers, near Paris; M. Maitre, Acieries et Founderies de l'Est, in the Doubs department, France; Marcel Remy, Herstel-lez-Liege, Belgium.

Professor Albert Portevin, well known for his study of metallography and his works on testing materials, has been appointed consulting engineer. The secretary of the association is M. Hiegel.

Designs Steel Foundry

Frank D. Chase, Inc., industrial engineers, Chicago, designed and supervised the erection of the plant of the Nugent Steel Castings Co., Chicago. The name of the Chase organization inadvertently was omitted from an interesting description of the plant which appeared in the March 15 issue of THE FOUNDRY.

The American Abrasive Metals Co., 50 Church Street, New York has been appointed by the Carborundum Co., Niagara Falls, N. Y., to act as United States representative in marketing an anti slip tile of its manufacture.

Talks on Cost System for Foundries

In discussing various managerial problems before the Newark Foundrymen's association at a meeting held in Newark, N. J., March 19, H. G. Specht, works manager of the Bassick Co., Bridgeport, Conn., stressed the importance of accurate cost data in the successful operation of a foundry. The prices made by some foundries are so low, he stated, that a number of large industries find it to their advantage to buy the castings outside rather than produce them in their own plant. This is not due to the fact that the large industrial firms have not sufficient requirements to keep a foundry department of their own in efficient operation, but rather is the result of the knowledge obtained from their own accurate cost system that they could not produce castings at even a small profit to themselves at a price comparable to that offered by various jobbing foundries, he maintained.

The low prices offered, he added, in some cases reflect clearly an inefficient cost system, which not only results in a substantial loss to the foundry making the offerings, but to all plants forced to compete with the low prices. Mr. Specht stressed the importance of a uniform cost system for foundries in a particular district, but also issued a warning that such a system should not be too involved. A good cost sheet is an index of many problems and may be used to particular advantage in keeping the overhead, the major cost item, at a minimum. This sheet will indicate the weak points in the various operating departments, and when once discovered, this trouble oftentimes may be removed quickly. He stated that mechanical methods may be employed often to excellent advantage.

It was announced that the cost system sponsored by the association has been adopted by practically 75 per cent of the foundries in Newark.

Foundrymen Meet

"Cupola Practice and Iron Mixtures" was the subject of a talk by J. H. Hopp, vice president, C. C. Kawin Co., Chicago, before the Quad City Foundrymen's association at a meeting held at the Le Claire hotel, Moline, Ill., March 17. The cupola as a melting unit was discussed from the viewpoint of generally accepted practice as to manner of operating, and suggestions were made with the view of improving the operation. It was recommended that the cupola charge be in proportion to the ladles used so that each tap may be considered as a complete metal charge. It also was recommended that the blast be shut off as much in advance of the dropping of the bottom as observation and practice permit for the purpose of preserving the lining of the cupola. The subjects of coke ratios and suitable mixtures for various classes of castings were discussed. The talk was followed by a discussion in which many took part.

Sand Cores Removed by Hydraulic Method

In the removing of 25,000 tons of sand cores at the Erie, Pa., works of the General Electric Co., last year the cleaning room labor force was reduced from twelve to two men because of the adoption of the hydraulic method of cleaning by forcing water through a hose and ¾-inch nozzle at the pressure of 250 pounds per square inch. This fact among others was disclosed by Carl B. Lockhart, the General Electric Co., Erie, Pa., who was the speaker at the regular March meeting and dinner of the Pittsburgh Foundrymen's association held at the General Forbes hotel, Pittsburgh, Monday evening, March 17.

In describing this method of cleaning large thin-section castings, which require much core work, Mr. Lockhart cited other savings in addition to the saving of labor. These include the recovery of sand, gravel and coke, the recovery of core rods and arbors, unbent and unbroken, the removal of waste by water which does away with handling; and the elimination of dust in the cleaning room. He said that on an initial expenditure of $4600 for installation, this company had saved $10,800 during 1923 and it was unable to wash all of the castings produced. According to Mr. Lockhart, a second cleaning room is being planned at the Erie works of the same general character as the first. In the new installation certain changes will be worked out which will increase efficiency and make possible the washing of the sand and gravel from the room instead of removing it by means of a grab bucket as now. For smaller castings a higher pressure than 250 pounds per square inch is recommended.

At this meeting a nominating committee consisting of Samuel B. Cuthbert, chairman, Thomas A. Reynolds and A. J. Hartman, was appointed by President John W. Guay of the Pittsburgh Foundrymen's association, to report at the April meeting. Mr. Cuthbert is affiliated with the Carnegie Steel Co., Braddock, Pa.; Mr. Reynolds with the McConway-Torley Co., Pittsburgh, and Mr. Hartman with the United Engineering & Foundry Co.

A motion was passed that President Guay appoint a member of the Pittsburgh Foundrymen's association to represent it on the sand committee of the American Foundrymen's association at the invitation of that latter body.

Publishes Bulletin on Metal Corrosion

Bulletin No. 6 Coal Mining Investigations, issued by the Carnegie Institute of Technology under the direction of the institute, the bureau of mines, and the advisory board of coal mine operators and engineers, deals with accelerated corrosion testing of metals and alloys in acid mine water. This investigation was conducted by Robert J. Anderson and George M. Enos, metallurgists, bureau of mines, and J. Richard Adams, research fellow, Carnegie Institute of Technology.

The bulletin describes in an interesting manner the accelerated chemical and electrolytic methods used for testing the corrosion of metals and alloys in acid mine water, and acid solutions. A number of tables are given showing the comparative loss in weight by chemical and electrolytic action on a number of test pieces which had been submitted by interested manufacturing concerns for that purpose.

The accelerated electrolytic corrosion test provides a rapid method that can be employed by mine operators in determining what metals and alloys are suitable for use in mine drainage equipment, and by manufacturers of mine pumps, and accessories in developing acid resisting metals and alloys.

Obituary

H. D. Megary, managing director of the Consolidated Pneumatic Tool Co., London, England, died March 20. Mr. Megary was born in Philadelphia April 21, 1888. He attended school in that city and graduated from the University of Pennsylvania in 1909. He then became affiliated with the Bethlehem Steel Co., where he remained until 1918. At that time he became connected with the Chicago Pneumatic Tool Co., as assistant to the president, later being made secretary of the company. In 1921 he was transferred to London as managing director of the English company. He was also director of European sales.

Wallace H. Linn, treasurer E. A. Williams & Son, Inc., Jersey City, N. J., died Monday, March 3.

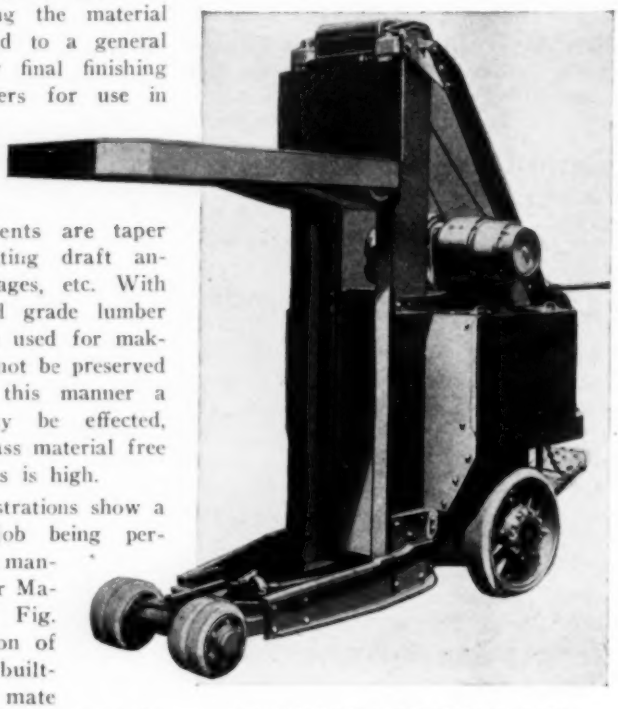
Disk Grinder Is Used in Making Patterns

The value of the disk grinder in reducing pattern shop labor has been established. This device may be used advantageously for shaping the material after it has been sawed to a general outline, as well as for final finishing operations. Disk grinders for use in the pattern shop now are equipped with many refinements for expediting work. Included in these refinements are taper adjustments for generating draft angles, circle-generating gages, etc. With the disk grinder, second grade lumber containing knots may be used for making patterns which need not be preserved for long periods. In this manner a considerable saving may be effected, since the cost of first class material free from knots and blemishes is high.

The accompanying illustrations show a typical patternmaking job being performed on disk grinders manufactured by the Gardner Machine Co., Beloit, Wis. Fig. 1 illustrates the operation of smoothing the faces of a built-up pattern section, the mate to which is shown on the bench at the left. This pattern is made of more than 20 separate pieces. Odds and ends of lumber often may be used in this manner so that the scrap pile is reduced materially. In general, patterns built from smaller pieces in this manner are more durable than if built from one piece.

After smoothing the faces of the built-up pattern section, the block is cut in two endwise and the halves are sawed roughly into a circular shape on the band saw. The ends of the pieces are ground parallel and to size on the disk grinder. By using the duplicating gage each one is made 7 inches long. The operator is shown grinding the diameter to the proper size in Fig. 2. At the same time a ½ degree draft in generated. The operation of finishing the peripheries completes the machine work and, with the exception of doweling and gluing the two halves together, the pattern is complete with no hand work required in finishing the construction.

The foregoing operations were performed with net-black garnet disks which resemble the so-called combination garnet paper and cloth. The disks are provided with loosely woven net cloth at the back. The paper backing of the disks is waterproof.



COMBINED LIFT TRUCK AND ELEVATOR

Develops New Heavy Duty Portable Elevator

The most recent development of the Elwell-Parker Co., Cleveland, manufacturer of electric trucks is a heavy duty lift truck which not only manipulates a loaded skid in the usual manner, but also will remove or deposit loads at any indicated point on a platform or loading stage at a height up to and including 72 inches above the floor. The machine is 112 inches in length, 95 inches high, may be driven through a 3-foot 6-inch doorway and has been designed to handle loads up to 6000 pounds. A safety or trip switch automatically limits travel and opens in case the outer end of the platform catches on an obstruction during its descent. The control is standard automatic to the extent that the operator cannot move the truck except when he stands on the rear pedals. The main switch may be closed and the power applied while brake is on. This feature is designed to secure safety of operation while traveling on ramps. The switch only closes while the controller drum is in off position. Immediately the operator steps from the truck, all electrical circuits are broken and the brake is applied. Truck complete and ready for active service weighs 5200 pounds,

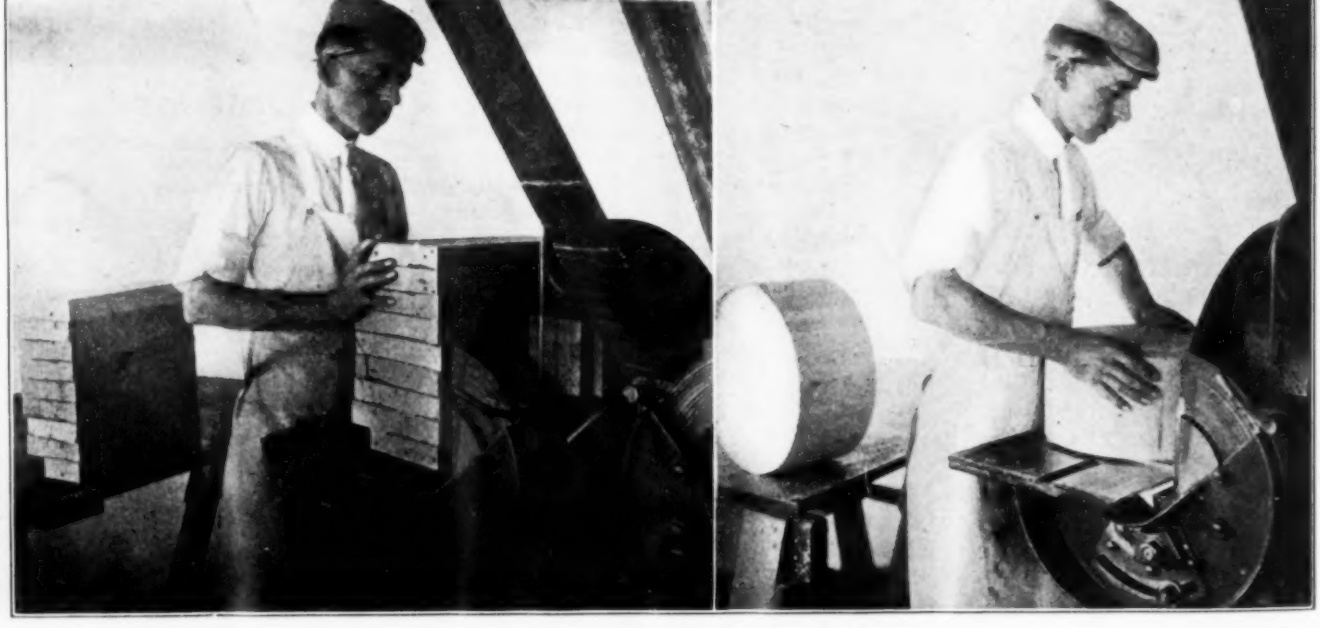


FIG. 1—(LEFT) THE PATTERN SECTIONS ARE FACED ACCURATELY BY DISK GRINDING FIG. 2—(RIGHT) THE DRAFT IS GENERATED AND THE PERIPHERY FINISHED IN ONE OPERATION

travels at 300 to 400 feet per minute and has a hoisting speed of 5 to 6 feet per minute.

Designs Swinging Type of Grinder

A swinging frame grinding and polishing machine has been introduced by the Excelsior Tool & Machine Co., East St. Louis, Ill. This machine is made in four sizes and designed for direct motor drive. The motor is placed high in the frame as a protection against excess dust found near the work. The motor balances the horizontal movement of the device while the counterweight balances the wheel end or vertical motion. Balancing all of the parts makes it easier for the operator to handle the grinder.

The type of machine shown in the accompanying illustration is entirely self contained. This makes it possible to attach the grinder to the hook of a traveling crane for raising or lowering as conditions may require. The heavy type grinders are applicable especially to steel and gray iron foundries, safe works, rail and frog shops, etc.

Builds Safety Switch for Starting Motors

The General Electric Co., Schenectady, N. Y., has placed a cover interlock on the market which is used with several of its magnetic starting switches. The device is designed particularly for use on starting switches installed in textile mills, woodworking shops and other places where inflammable dust or flyings are present. The interlock makes it necessary for the operator to keep the cover tightly closed to operate the switch, thus reducing the possibility of combustion following the accumulation of dust inside the switch box. The device consists of two contacts which complete the circuit only when the cover of the starting switch is closed tightly.

Universal WoodWorking Bench Machine

Among the many claims set forth for the machine shown in the accompanying illustration and manufactured by the DeWalt Mfg. Co., Leola, Lancaster, Pa., are that it may be employed as a tenoner, a rip saw, compound crosscut saw, machine knife grinder and a shaper. With the addition of a flexible shaft attachment it may be converted into a drill capable of drilling holes up to ¾-inch diameter. The same attachment may be utilized with polishing, cleaning or grinding equipment. The machine also may be employed for operating two auxiliary devices, a lathe and a jig saw and on that account, it is stated, is particularly suitable for use in the pattern shop, the cabinet shop and the manual training school. The device is direct motor driven and it is said may be changed from one kind of work to another with little or no loss of time.

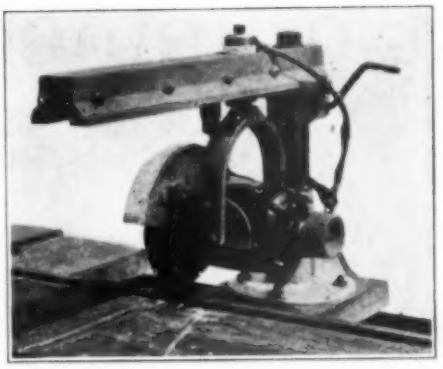
MOTOR DRIVEN GRINDER AND POLISHER APPLICABLE TO FOUNDRIES

It will cut material 2 inches thick, 15 inches wide and any length.

Industrial Tractor Has Crane Attachment

A small industrial truck and tractor with a crane attachment recently has been introduced by the Clark Tructractor Co., Buchanan, Mich. Compactness has been featured in the design of this truck which pivots on one wheel and has a turning radius of 52 inches. It is said that it may be turned around in a box car. The truck is powered to tow from 7 to 10 tons or from 1 to 20 trailers, depending on the condition of the factory floor or yard.

A 1-ton crane may be attached without the use of tools, thus converting the tractor into a mobile crane. A brake device on the crane permits the load to be carried at any height up to 56 inches, and allows the load to be lowered at will. The truck has three wheels and is driven by a gasoline engine. Traction is provided by 16-inch wheels equipped with 3½-inch solid rubber tires. The truck has a wheelbase of 40 inches with a 33-inch tread. A brake beneath the driver's seat automatically stops the machine when the driver dismounts. The machine is designed for loading and unloading box cars, lifting and towing loads through narrow factory aisles and other interplant haulage. It may be used for craning and transporting materials in and about industrial plants, foundries, railroad stations and terminals, machine shops, warehouses and storage yards.



MOTOR DRIVEN MACHINE MAY BE ADAPTED FOR PRACTICALLY ANY WOODWORKING PURPOSE

J. H. Chaplin, vice president and director of sales of the Root Co., Bristol, Conn., has sailed for England where he will supervise the installation of the products of this company in several of the large textile mills and will study manufacturing methods of that country.

COMPACT CONSTRUCTION MAKES POSSIBLE TURNING RADIUS OF ONLY 52 INCHES

Equipment Buying Is Lagging

Volume of Sales in March Was Light but Large Number of Inquiries Indicate Heavy Potential Demand for Equipment—Foundry Market for Cranes Is Fairly Active

WHILE inquiries for foundry equipment now before the trade point to a substantial business in this market during the month of April the volume of sales during March was not up to expectations. Apparently many foundries plan additions or replacements of machines, but are delaying closing on the large lists, confining purchases to actual needs. Heavy buying of cars and locomotives by railroads is causing increased activity in plants handling this type of work, and probably will result in heavier equipment buying in the near future. The W. W. Sly Mfg. Co., Cleveland, has sold tumbling barrel equipment to the West Park Foundry Co. and the Fanner Mfg. Co., Cleveland, and Cincinnati Steel Castings Co., Cincinnati. The National Supply Co., Toledo, and the Ohio Malleable Iron Co., Columbus, have closed on sand blast and dust arrester equipment with the Pangborn Corp., Hagerstown, Md. The Stoney Engineering & Foundry Equipment Co., Cleveland, has sold four molding machines to the New York Air Brake Co., Watertown, N. Y., and two to the Westinghouse Air Brake Co., Wilmerding, Pa. The Ferro Machine & Foundry Co., Cleveland, has closed on 20 machines with the same manufacturer.

Pittsburgh Sees Better Business

INTERMITTENT buying of foundry equipment is noted in the Pittsburgh area although a large number of inquiries are pending on which action is promised during April. These inquiries include practically everything wanted in foundries from sand blast machinery, core ovens and cupolas to smaller supplies and equipment such as riddles, flasks and wheelbarrows. A few small orders for the latter type of equipment were noted during the past two or three weeks although outstanding individual orders are lacking. In molding machines the market has been fairly active, the Herman Pneumatic Machine Co. reporting single orders for their large rollover machines from the following: Ingersoll-Rand Co., Painted Post, N. Y.; Huntspiller Mfg. Co., Boston; T. H. Symington Co., Rochester, N. Y.; U. S. Hoffman Machinery Co., Inc., Syracuse, N. Y.; the Raritan Foundry Co., Raritan, N. J.; the National Foundry Co. of New York., Inc., New York; the Standard Scale & Supply Corp., Beaver Falls, Pa.; the Franklin Foundry Co., Franklin, Pa.; and the National Foundry Co., Erie, Pa. The American Steel Foundries, Pittsburgh, ordered two machine of this type. The Westinghouse Air Brake Co., Wilmerding, Pa., is understood to be contemplating the purchase of considerable foundry equipment for its new brass foundry addition, including grinding machines, tumbling barrels, sand blast machinery, etc. The Standard Sanitary Mfg. Co. is about to close on electric furnaces and considerable foundry equipment of all sorts, including sand-blast, sand-cutting and sand-conveying machinery for its new Baltimore plant. This company already has purchased the machine tool equipment for that plant involving 22 items or more, the order for about 20 going to Niles, Bement, Pond Co., including two grinders. Two radial drills went to the Motch & Merryweather Co. and an open-side planer also was bought. The 15 or 20 grinders for its cleaning room at Baltimore as yet have not been purchased. The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has purchased a number of machine tools for its Homewood, Pa., plant, including two milling machines, two radials and two turret lathes. Additional equipment will be bought for both East Pittsburgh, Homewood and Sharon, Pa., plants. Levering Bros., Baltimore, have purchased a sand blast unit with dust arrester and the Duquesne Steel Foundry Co., Coraopolis, Pa., has closed on dust arester equipment with the W. W. Sly Mfg. Co., Cleveland. The same company has sold tumbling barrels to the American Malleables Co., Lancaster, N. Y., and the Graff Furnace Co., Scranton, Pa. The Buckwalter Stove Co., Royersford, Pa., has purchased sand blast and dust arrester equipment from the Pangborn Corp., Hagerstown, Md.

The crane market has been fairly active from a foundry standpoint, the Standard Sanitary Mfg. Co. placing its order for six 5-ton cranes of special design for its new Baltimore foundry with the Pawling & Harnischfeger Co., Milwaukee. This company purchased a 5-ton standard crane for the machine shop from the Chesapeake Iron Works. The Lynchburg Foundry Co., Lynchburg, Va., bought a 20-ton used locomotive crane from an unnamed seller, while the Frog Switch & Mfg. Co., Carlisle, Pa., awarded a 20-ton electric crane with 55-foot span to an eastern builder and the Hershey Machine & Foundry Co., Manheim, Pa., closed on two 3-ton single I-beam cranes with 28-foot span with the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Sales Heavier in New England

SALES of foundry supplies increased noticeably during March, but foundry equipment has moved somewhat slowly. Dealers feel that heavy potential buying exists, but are awaiting greater confidence in the future before the orders actually will be placed. Several new foundries and foundry additions within the district are being built and equipment is required for these. Several sales of small cranes, sandblast equipment, and molding machines recently have been made to a scattered list of foundries. A foundry in Everett, Mass., brought a 3-ton traveling crane. The Builders Iron Foundry, Providence, R. I., has plans for an addition and is in the market for equipment. The Rhode Island Malleable Iron Works, Hills Grove, R. I., also is understood to be in the market in connection with a plant addition. The Guerney Heater Mfg. Co., Framingham, Mass., is planning a foundry addition. The James Hunter Machine Co., North Adams, Mass., has ordered complete sand blast and dust arrester equipment from the W. W. Sly Mfg. Co., Cleveland. The same manufacturer has sold tumbling barrel equipment to Landers, Frary & Clark, New Britain, Conn. The Murray Iron Foundry Inc., Boston, has closed on sand blast and dust arrester equipment with the Pangborn Corp., Hagerstown, Md.

Sales Again Slow Up In East

FOUNDRY equipment sales the past few weeks again have slowed up. With few exceptions no large orders have been placed. At the same time, inquiries have been scattered and for the most part have involved only single

items. One large seller has stated that business so far this year has been less than 75 per cent of that for the corresponding period of 1923. The increased volume of railroad buying, however, gives promise of greater activity in foundry equipment in the near future. Already this buying is being reflected in better operations at many of the jobbing foundries, and it is now that substantial work remains to come out. Of special encouragement in connection with railroad buying have been recent sizable orders for locomotives. In the New York and Newark foundry districts, operations at many of the jobbing foundries are approximately 75 per cent; in the Philadelphia district, the average does not appear to be as high.

A recent buyer is the Dupont Engineering Co., Wilmington, Del., which has closed on several items of equipment, with a particular view to eliminating much of its recent labor difficulties. The Standard Sanitary Mfg. Co., Baltimore, continues to be an active buyer. The Lynchburg Foundry Co., Lynchburg, Va., closed on a used 20-ton locomotive crane from an unnamed builder.

Chicago Experiences Light Activity

MANUFACTURERS of foundry equipment in the Chicago district are experiencing no slackening in the number of inquiries is being brought out but are finding it extremely difficult to translate inquiries into sales. Many foundries are desirous of adding to or improving their equipment, but do not feel warranted in going ahead at this time. Recent sales by the Whiting Corp., Harvey, Ill., include cupolas to the board of education at Toledo, O., and the Hansell-Elcock Co., Chicago. The National Engineering Co., Chicago, has placed sand mixers in the plants of the Du Pont Engineering Co., Wilmington, Del.; National Malleable & Steel Castings Co., Indianapolis; and the Great Lakes Foundry Co., Port Huron, Mich. The Whiting Corp. has installed drawer-type core ovens in the foundry of the Northern Indiana Brass Foundry Co., Elkhart, Ind. Sand blast and dust arrester equipment has been sold to the Vulcan Plow Co., Evansville, Ind., the Hoffman & Billings Mfg. Co., Milwaukee, the Muller Metals Co., Inc., Port Huron, Mich., the Waukegan Foundry Co., Waukegan, Ill. and Kay & Brunner, Los Angeles, Cal., by the Pangborn Corp., Hagerstown, Md. The Griffin Wheel Co., Chicago, has ordered a steel cinder mill barrel from the W. W. Sly Mfg. Co., Cleveland. Other sales of tumbling mill equipment by the W. W. Sly Mfg. Co. include machines for the Maxwell Motor Co., Inc., Detroit, and the Chicago Bearing Metal Co., Chicago. The National Brake & Electric Co., Milwaukee, and the American Car & Foundry Co., Madison, Ill., each have closed on one large roll-over machine from the Herman Pneumatic Machine Co., Pittsburgh.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The Aetna Aluminum & Brass Casting Co., Chicago, has been dissolved.

The Columbia Malleable Castings Corp., Portland, Me., has been incorporated for $150,000 with Charles D. Booth as president.

The Pacific Stove & Foundry Co., Tacoma, Wash., has been incorporated for $35,000 by E. N. Stenberg, 505 California building.

United States Cast Iron Pipe & Foundry Co. plant at North Birmingham, Ala., was damaged by fire recently.

Berkley Machine Works & Foundry Co., foot of Mulberry street, Norfolk, Va., operator of gray iron, brass and aluminum foundries, was badly damaged by fire recently.

Temple Foundry, Inc., Alexandria, Va., has been incorporated for $25,000 by Victor E. Beagle and Frank Michelbach, the former being president and the latter secretary.

The Berkeley Brass Foundry Co., Berkeley, Cal., has been incorporated at 2629 Seventh street, to make brass and aluminum castings, with Walter Eggers as manager.

The H. & R. Foundry Co., Cincinnati, has been incorporated for $5000 to $25,000 by Harry Hinken, Arthur Remers, Louis Ostrov, Elmer A. Young and Edward F. Korten.

A. H. Coplan Co., Hull, Que., has completed plans for the erection of a gray iron foundry estimated to cost about $50,000 on a site near Ogdensburg, N. Y.

The New England Iron Works, Boston, has awarded construction contracts for an addition, one story, 130 x 180 feet, to foundry and machine shops.

Rockford Brass Works, Rockford, Ill., operator of brass and aluminum foundries, will occupy a 6-story plant to be built at 650 South Main street.

Jenkins Bros., Bridgeport, Conn., valve manufacturer and operator of steel, brass and aluminum foundries, recently added a new plant to its operating capacity. The additional facilities will be used for producing iron valves which previously had been manufactured on contract.

Consolidated Foundry Co., New York, has been incorporated for $10,000 by R. H. Robbins and M. F. Nally with J. T. Crane, 2 Rector street, as attorney.

Valley Iron Works Co., Appleton, Wis., operator of gray iron and brass foundries and builder of paper mill machinery, has increased its capitalization from $400,000 to $550,000 and plans expansion of capacity this summer.

Phillips & Buttorff Mfg. Co., Twelfth avenue north, Nashville, Tenn., recently completed a new foundry, three stories, 100 x 136 feet. The new unit will be used for manufacture of furnaces.

The Liberty Brass & Bronze Foundry, San Francisco, operator of brass and aluminum foundries, has moved its offices and plant from 248 Tehama street to Sherman and Cleveland streets.

Greene, Tweed & Co., 47 Hamilton street, Newark, N. J., with main offices in New York, has awarded general contracts for $35,000 plant to Enstice Bros. The company manufactures small tools.

Lima Brass & Iron Foundry Co., 228 East McKibben street, Lima, O., operator of gray iron, brass and aluminum foundries, will expand plant to accommodate recent large orders received. J. B. Rountree is general manager.

William Sellers & Co., Inc., Sixteenth and Hamilton streets, Philadelphia, builder of machine tools and operator of gray iron and brass foundries, will let general contract shortly for erection of $50,000 plant addition.

H. S. Getty & Co., Inc., Stokeley street, below Huntington park, Philadelphia, has retained Walker & Carswell as architect, for addition to foundry. Preliminary plans have been completed.

Mueller Iron Foundry Co., 2000 East Eldorado street, Decatur, Ill., has been incorporated for $25,000 to do a general foundry business, by W. E. Mueller, Robert H. Mueller and Henry A. Bohl.

Damez Foundry Co., 7380 South Chicago avenue, Chicago, has been incorporated for $25,000 to manufacture and deal in iron, metal, castings, etc., by William B. Gemmill, D. Canavan and Ernest R. Reichmann.

Wolff Mfg. Co., 255 North Hoyne street, Chicago, has let construction contracts to the Austin Co., 208 South La Salle street, for enameling plant and remodeling warehouse into a brass foundry and light machine shop.

American Steel Foundries, 322 South Michigan avenue, Chicago, has taken out permits for three buildings to cost about $75,000 in East Chicago, Ind. Kenwood Bridge Co. will do the constructing.

Hart & Crouse, 301 Turner street, Utica, N. Y., plans 1-story, 144 x 204-foot foundry costing about $200,000. H. R. Beebe, Utica City National Bank building, is general contractor.

J. H. H. Voss has been incorporated in New York to make valves with $100,000 capitalization by J. H. H. Voss, A. Voss and C. Bauer, with J. K. Ellenbogen, 220 Broadway, New York, as attorney.

Builders Iron Foundry, 9 Codding street, Providence, R. I., operator of gray iron, brass and aluminum foundries, plans a 1-story, 35 x 80-foot brick machine shop and storage building. Monks & Johnson, 99 Chauncey street, Boston, is architect.

Sage Economy Radiator Co., Watertown, N. Y., has been incorporated with 2500 shares $100 par value preferred and 6000 shares no par value common stock, by J. C. and F. K. Purcell and P. A. Pitcher. Purcell, Cullen & Pitcher is attorney.

Newton Morris has taken over the share of his brother, Oscar Morris, in the Morris

Bros. foundry, Fond du Lac, Wis., operator of brass and aluminum foundries. A 42 x 72-foot foundry addition and pattern storage vault recently was completed.

General Iron Works Co., Los Angeles, will construct a $1,000,000 foundry at Denver, according to reports of Robert W. Gordon, general manager of the Stearns-Roger Mfg. Co., Denver, manufacturer of mill and mine supplies.

Champion Hardware Co., Geneva, O., operator of gray iron, brass and aluminum foundries, has retained Lockwood, Greene & Co., engineer and builder, to render engineering service on a 3-story reinforced concrete building, 50 x 130 feet.

Thomas C. Olson Co., 609 East Washington avenue, Madison, Wis., has been incorporated to manufacture and deal in machinery, mechanical supplies, make castings, etc., by Thomas C. Olson, Clarence E. Lee and Edward K. Olson.

Haines, Jones & Cadbury, Inc., 1128 Ridge avenue, Philadelphia, operator of gray iron and brass foundries in that city and Norristown, Pa., is taking bids on general contract for the erection of an $80,000 branch plant at Wilkesbarre, Pa. McCormick & French, Wilkesbarre, are the architects.

Peckham Brass Foundry, Inc., Boston, recently incoporated with $15,000 preferred and $35,000 common stock, has taken over the business of F. W. Peckham, brass founder, 155 A street. No immediate expansion is planned. The company makes brass, bronze, composition and aluminum castings.

The Oakland Furnace & Foundry Co., Oakland, Cal., has been incorporated for $100,000 by John E. Hyatt, John Newman and F. L. Holbrook. The foundry formerly used by the Fageol Motor Co., Fourth street and Bancroft way, Berkeley, has been taken over and the company is making castings for its furnaces.

Anniston Foundry Co., Anniston, Ala., William H. Deyor, secretary and manager, has let construction contracts to Ogletree Construction Co. to erect a 40 x 60-foot, a 30 x 90-foot and a 25 x 280-foot building. Equipment to be purchased includes planers, lathes, shapers, drill press and tapping machines, most of which have been ordered.

Ward Railway Equipment Co., Lima, O., recently incorporated for $50,000, will construct a building 100 x 400 feet, to be equipped as a modern gray iron foundry. The company intends to specialize in the manufacture of safety and time-saving appliances for railroads on which it holds patent rights. Joseph T. Ward is president, George T. Shambow vice president, Edward P. Kiely treasurer and Oscar G. Snyder secretary.

Western Iron & Foundry Co., Second and Santa Fe streets, Wichita, Kans., contemplates constructing 60 x 140-foot plant addition, just north of the present building at 702 East Second street. Considerable new equipment, including cranes, drills, hammers and other machinery, are to be installed. The company fabricates structural and architectural iron and steel and does a general foundry, machine and boiler shop business. Definite plans are expected to be formulated by the middle of 1924. J. F. Warren is president, Henry Anthony, manager, F. J. Anthony, vice president and J. Q. Warren, secretary and treasurer.

New Trade Publications

SWITCHBOARD INSTRUMENTS—Roller-Smith Co., Bethlehem, Pa., and New York, in a recent bulletin, provide a catalog of direct current switchboard instruments with descriptions, prices and other necessary information.

MOLDING MACHINES—The Johnson & Jennings Co., Cleveland, in a well-prepared 32-page booklet shows halftones of its molding machines as well as views of installations. Descriptions of the several types are included and their adaptation to various uses in producing castings shown.

PICKLING—The Matthew Addy Co., Philadelphia, has issued a 32-page booklet to set forth the advantages of a compound to be added to the acid solution in the pickling process to prevent waste of acid and metal by modifying the acid to avoid some of the usual evils. Numerous useful reference tables are included.

GRINDING—The Cleveland Stone Co., Cleveland, The Sterling Grinding Wheel Co., divison. Tiffin, O., gives a description of Sterling wheels together with tables of data helpful to users of grinding wheels in a 52-page booklet. Halftones and line drawings aid much in making plain the statements in the text.

RESISTANCE ALLOYS—Under the title of Nichrome the Driver-Harris Co., Harrison, N. J., has issued a booklet of 56 pages describing alloys for electrical resistance, their application to various specific uses, temperature resistance curves and tables and a wealth of reference matter relating to the alloys and other closely allied subjects.

VIBRATION ISOLATION—W. Christie & Grey, Ltd., London, England, in a 12-page booklet describes and illustrates methods used to prevent necessary machinery being a nuisance from its noise and a menace to structural safety from its vibration. The machine is protected from vibration by a special foundation.

PORTABLE AIR COMPRESSOR—Sullivan Machinery Co., Chicago, has issued a regular form bulletin devoted to a description of portable air compressors designed for rock removal in road building or city streets or for any task requiring small volumes of compressed air for short periods at scattered points.

LIFTING CRANES—Herbert Morris, Inc., Buffalo, N. Y., has issued a booklet describing its cranes and hoists in detail, as well as accessories for making hoisting safe and easy. Details of the cranes and appliances are fully illustrated and proper installations for varied uses are indicated. Drawings and tables to guide the proper selection are included.

BELTING—The Goodyear Tire & Rubber Co., Akron, O., has published a handbook on conveyor and elevator belting. The handbook outlines certain principles of design and operation applying to all belt conveyors and belt elevators, which if carefully observed, will insure long wear and satisfactory service. The book is well illustrated and contains a number of working tables.

SQUEEZERS—Air squeezers for foundry use are described in a folder recently published by the Adams Co., Dubuque, Iowa. The piston of this machine is 12 inches in diameter and the working surface of the table is 16 x 22 inches. This machine is built in either the stationary or the portable types. Other foundry equipment such as flasks, presser boards, bottom boards, weights, sprue cutters, pneumatic rappers and pattern vibrators, also are described.

TUMBLING MILLS—A 32-page booklet recently published by the W. W. Sly Mfg. Co., Cleveland, covers in a thorough manner the subject of cleaning castings by tumbling. The common uses of tumbling mills together with a number of installations are described in detail. Construction, the various methods of driving, arrangement and operation are discussed at some length. Dust arrestors also are described and illustrated.

STAINLESS STEEL—The Firth-Sterling Steel Co., McKeesport, Pa., has published a 62-page, cloth-bound volume giving the history, applications and types of stainless steel together with an account of the heat treatment and working necessary to its production. Information on chemical analysis and resistance to various agencies of rust, stain and corrosion is included. The book is embellished by various tables and graphs illustrating the subject.

ELECTRICAL INSTRUMENTS—Direct current portable instruments are described and illustrated in a 12-page folder published by the Roller-Smith Co., 233 Broadway, New York. The first portion of the folder is devoted to a treatise on the general principles of design used in these instruments. Included in the list of products of this company are ammeters, millimeters, voltmeters, millivoltmeters, volt-ammeters, galvanometers, shunts and multipliers.

OIL BURNERS—The Combustion Engineering Corp., Broad street, New York, recently has issued a pamphlet on a new type of oil burner. The burner, which is applicable to stationary boilers or to burning of oil for other purposes, is designed especially for refining work. The pamphlet contains a general description of the burner with information on the performance and applications of the device. A sectional diagram of the burner also is included.

WOODWORKING MACHINERY—An exceptionally complete catalog, bound in cloth and containing 320 pages, recently has been distributed by the Oliver Machinery Co., Grand Rapids, Mich. The products of the company are well illustrated and described at length. In addition, exterior and interior views of the plants of the company are shown together with illustrations of a number of installations of machinery. Methods now in use for packing and crating machinery for shipment also are shown.

CLAMSHELL BUCKETS—The Blaw-Knox Co., Blawnox, Pa., have published a 52-page booklet describing the types and sizes of buckets it manufactures. The types furnished include a bucket having great closing power with few moving parts, a fast rehandling bucket, a bucket for handling heavy lumpy material, a single line bucket, a single line foundry bucket, single rope cableway, wheel bucket, etc. The publication is illustrated with views of the types of buckets described and also of actual installations. Other products of this company also are mentioned.

INDICATING INSTRUMENTS—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a 24-page illustrated booklet entitled "Indicating Instruments for Direct and Alternating Currents." The first portion of the book includes a resume of the developments of electricity with special reference to the development of alternating current and the earlier alternating current instruments, while the remainder of the booklet is devoted to a description of the type of instruments now being manufactured. The last chapter is devoted to a discussion of instrument application.